CURTISS P-40

Long-nosed Tomahawks

CARL MOLESWORTH

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AIR VANGUARD 8

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INTRODUCTION

This story of the Curtiss P-40 line of World War II fighter aircraft starts with a photograph taken more than a century ago. On August 20, 1910, Army Lt Jacob E. Fickel was photographed sitting in the passenger seat of a crude Curtiss pusher biplane, holding a .30-caliber Springfield rifle. Pioneer aviator Glenn Curtiss sits by his side in the pilot's seat.

Moments after the picture was taken, Curtiss took off from Sheepshead Bay Race Track near New York City. He climbed to an altitude of 100 feet and turned to make a pass over the race track. As the biplane crossed the infield, Lt Fickel took aim at a 3ft by 5ft target set up there and opened fire. It was the first time a military firearm had been discharged from an airplane. History does not record if Lt Fickel hit the target, but he nevertheless had set off a chain of events that would culminate in full-scale aerial warfare over Europe starting four years later.

Glenn Curtiss, an early proponent of military aviation, formed the Curtiss Aeroplane & Motor Company in Hammondsport, New York, and produced the iconic JN-4 "Jenny" biplane trainer during World War I, along with a series of successful flying boats and other aircraft. He retired in 1920, but his company went on to become the largest American airplane and aircraft engine manufacturer in the United States during the 1930s after merging with Wright Aeronautical.

Curtiss, the airframe division of Curtiss-Wright Corporation, built all manner of military and commercial aircraft during its heyday, but it was best known for its line of Hawk pursuit planes. Starting with the PW-8 in 1924, Curtiss produced a steady stream of Hawks for the US Army, US Navy, and overseas export. The transition from biplane to monoplane arrived with the Model 75 (P-36), and the last production Hawk, P-40N-40 serial number 44-47964, rolled off the assembly line in Buffalo, New York, on November 30, 1944. By then, Curtiss had built 15,479 Hawks.

The initial version of the P-40, designated by the manufacturer as the Hawk 81, combined the established airframe of the earlier radial-powered P-36 with the Allison V-1710 liquid-cooled engine. The year was 1939, and the marriage was one of expediency. With the threat of war in Europe growing by the day, the US Army Air Corps (USAAC) command wanted a modern fighter that would combine the sterling handling qualities of the P-36 with a boost in performance that would make it competitive with the new types emerging in Germany and England, and the generals wanted the new plane immediately.

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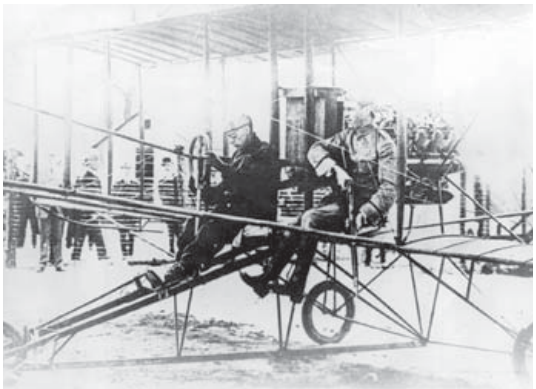
The P-40 delivered admirably, and though it never reached the performance levels of the later-model Bf 109 or Spitfire, the sturdy airplane nevertheless made a place in history for itself as the Army's frontline fighter when the US entered World War II. Long-nosed P-40s initially saw combat in North Africa, flying in Desert Air Force (DAF) squadrons. They also fought in the skies over Pearl Harbor and the Philippines. But the long-nosed P-40 is best known as the shark-faced fighter flown by the American Volunteer Group – the legendary "Flying Tigers" – over Burma and China during 1941 and 1942.



On August 20, 1910, Army Lt Jacob E. Fickel fired his .30-caliber Springfield rifle from a Curtiss pusher biplane, while pioneer aviator Glenn Curtiss piloted the plane. It was the first discharge of a military weapon from an airplane in history.

The P-40 was an honest, tough, and reliable fighter. Though some pilots groused about its relatively slow rate of climb and its inability to operate at high altitude, others appreciated its firepower, maneuverability, and diving speed. Admittedly outclassed by the new generation of fighters that succeeded it by the midpoint of the war, the P-40 nevertheless soldiered on through to V-J Day in 1945.

This will be the first of two books in Osprey's Air Vanguard series covering the Curtiss P-40. Here we will cover the Hawk 81 model, otherwise known as the "long-nose" P-40. The second book will take up with the Hawk 87, covering the P-40 line from the D-model to the end. Having spent a good part of my life since boyhood fixated on the P-40, it is my honor and pleasure to have been chosen by Osprey to write these books.

DESIGN AND DEVELOPMENT

Birth of the Curtiss Hawk

The end of World War I in November 1918 was a mixed blessing for the American aircraft industry. Companies such as the Curtiss Aeroplane & Motor Co. of Buffalo, New York, were encouraged by the reversal of the US Army wartime policy of using only foreign-designed aircraft in combat squadrons. In theory, this change would spur growth in domestic design and manufacturing of military aircraft. But the reality of peacetime procurement soon set in: In the wake of the "war to end all wars," not only would budgets for new military aircraft be extremely small but also the flood of war-surplus aircraft unleashed by the military would engulf the civilian market as well.

The clean lines of the original Curtiss Hawk – the PW-8 – show up in this January 1923 portrait. Incorporating the radiator into the skin of the top wing reduced drag, but the idea was impractical for a combat aircraft. (Glenn H. Curtiss Museum, Hammondsport, New York)

Demand for new airplanes languished for three years before the US Army Air Service made its first big postwar purchase of 200 MB-3A fighters from a relatively new Seattle enterprise, the Boeing Airplane Company. The MB-3A was a single-seat biplane closely resembling the famous French SPAD scout, a 1916 design. Though the Army command was satisfied that the MB-3A would serve their needs well into the 1920s, Curtiss executives thought differently. They believed they could build a fighter of advanced design with substantially improved performance that would force the Army to buy it.

Chief Engineer William Gilmore set to work refining the designs he had developed for a series of

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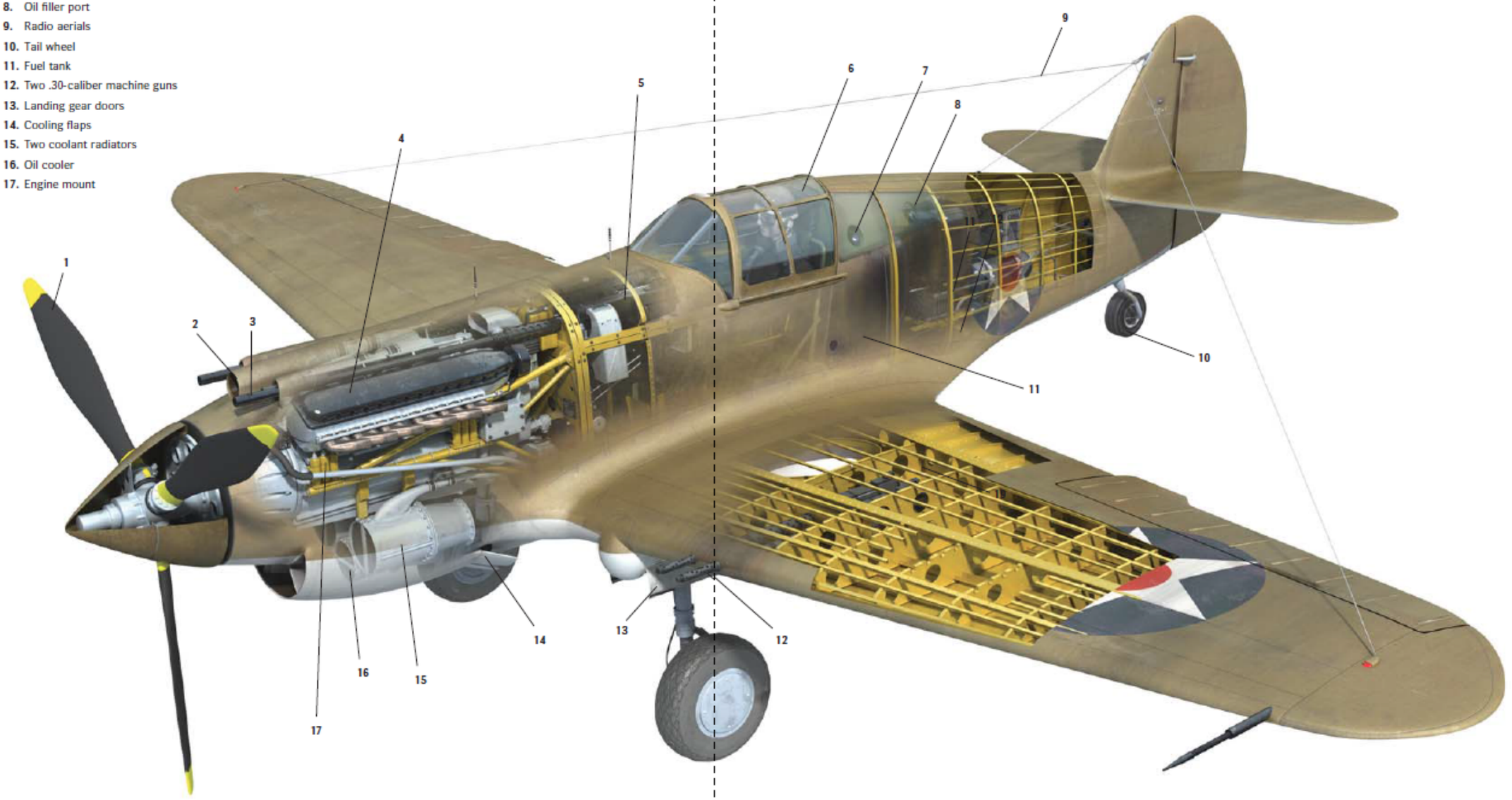
A CURTISS P-40B

Key

1. Curtiss Electric propeller
2. Carburetor air intake
3. .50-caliber machine gun muzzles
4. Allison V-1710-33 engine
5. Two .50-caliber machine guns
6. Pilot's seat
7. Fueling port
8. Oil filler port
9. Radio aerials
10. Tail wheel
11. Fuel tank
12. Two .30-caliber machine guns
13. Landing gear doors
14. Cooling flaps
15. Two coolant radiators
16. Oil cooler
17. Engine mount



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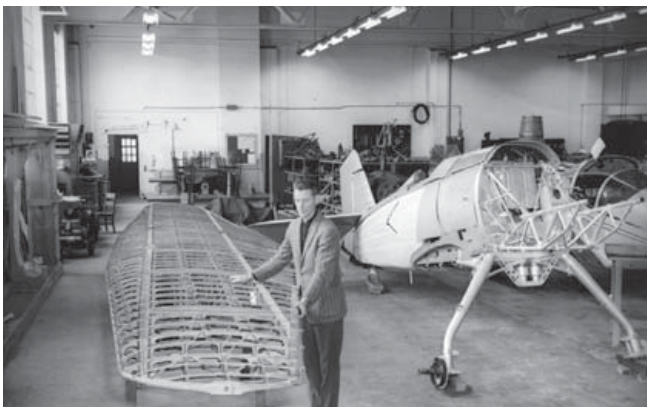

This 1963 view of the restoration of a P-6E by the Air Force Museum shows off the structure of the classic tapered Curtiss Hawk wing. Also visible is the sturdy motor mount structure for the plane's Conqueror engine.

postwar Curtiss racers, and soon delivered plans for his new fighter to the Army's Material Division at McCook Field, Dayton, Ohio. Officials there were impressed with the new design but had no procurement authority. They did, however, offer Curtiss a challenge. If Curtiss would build three prototypes at its own expense, using engines, armaments, and instruments provided by the Army, the division would agree to test the new planes on a bailment contract. They made the same offer to Boeing, setting up a fighter rivalry that would last for the next decade.

Curtiss built its new fighter around the 435hp Curtiss D-12 water-cooled engine, and testing began at Selfridge Field in July 1924. The plane's fuselage was a conventional welded steel tube structure, and armament consisted of one .50-caliber machine gun and one .30-caliber weapon. The original wing design changed twice before Curtiss settled on the tapered version of wooden spars covered in fabric that would become a staple of Curtiss biplanes for the next decade. At the same time, the troublesome radiators that formed part of the wing surface were replaced by a tunnel-type radiator under the nose.

The Army was impressed by the plane's 168mph top speed and purchased the three prototypes, then gave Curtiss an order for 25 production models. The third prototype was entered in the 1924 Pulitzer Air Race and finished third behind two purpose-built racers. Curtiss's new fighter was designated the PW-8 (Pursuit, Water-cooled, Model 8), and in 1925 the next production version became the P-1. The Navy followed with orders for a similar version, the F6C. However, in the aviation community, Curtiss fighters from the P-1/F6C to the dawn of the jet age would be known simply as "Curtiss Hawks."

The Biplane Hawks

Curtiss would go on to build more than 700 Hawk biplane fighters, the last ones rolling off the production line in June 1938. The steady stream of orders for Hawks from the US Army and Navy plus export customers was a big factor in Curtiss's ability to stay afloat during the lean years of the Great Depression while also keeping pace with the technical advances of this period.

The Army placed orders for no fewer than 16 different Hawk models, from the P-1 through to the XP-23, between 1924 and 1932. Many of these Hawks were one-off and short-run prototypes, and the two major production series were the P-1 and the P-6.

Curtiss built 154 P-1s in six orders through to the P-1F, each subtype slightly advanced over the previous model. Ironically, performance dropped as the airframe gained weight from additional equipment but the output of the D-12 powerplant remained the same. These aircraft, along with a similar number of contemporary Boeing PW-9s, constituted the frontline pursuit strength of the Army Air Corps though 1929. They remained in service as trainers until 1936.

The P-6 evolved from the decision to fit two existing Hawk airframes with the new Curtiss V-1570 Conqueror engine to compete in the 1927 National Air Races. The engine, modified to produce 730hp for racing, propelled the

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Hawks to first and second places in the closed course race. The winner, flown by Lt E. C. Batton, averaged 201mph for the race.

The success of the 1927 racers convinced the Army to fit production line Conquerors, delivering 600hp, in the Hawk airframe to create the P-6B. These were the first Army fighters to replace water with ethylene glycol as the cooling agent for the engine. More effective as a coolant while also resisting freezing, ethylene glycol allowed a smaller radiator to be fitted, which reduced weight and aerodynamic drag. The most numerous of the later Hawks was the P-6E, which featured a three-blade propeller and wheel pants. Curtiss delivered 45 P-6Es from December 1931 through March 1932, and they continued in Army service until 1939.

The US Navy ordered its first Hawks, nine F6C-1s identical to the P-1, in January 1925. The F6C-2 soon followed, with beefed-up landing gear and an arrester hook for carrier operations. When the Navy decided to limit its carrier-based aircraft to air-cooled engines in 1926, Curtiss responded with the F6C-4, powered by a Pratt & Whitney R-1340 Wasp producing 420hp. The Navy bought 31 of them.

Curtiss delivered 102 Hawk IIIs to the Chinese Air Force between March 1936 and June 1938. Similar to the Navy's BF2C-1, the Hawk III featured retractable landing gear but had the original Hawk wooden wing structure.

The F7C Seahawk was the first Curtiss fighter specifically designed for carrier operations and dive-bombing. These were assigned to the Marines, who flew them until 1933. Most unusual was the diminutive F9C Sparrowhawk, a parasite fighter to be carried inside the Navy airships *Akron* and *Macon*. Eight were manufactured.

The F11C began life as a company demonstrator for the export market, combining the P-6 airframe with a Wright R-1820 radial engine. Later versions of the F11C, which was renamed the BF2C when the Navy assigned it to the fighter-bomber mission, introduced closed cockpits, metal wing structure, and retractable landing gear. Production of Hawks for the Navy closed in November 1934, but foreign customers kept Curtiss building biplane Hawks for nearly four more years.

Curtiss actually sold more biplane Hawks on the export market than it sold to either the Army or the Navy. Ten countries bought Hawks, with China being the biggest customer. Bolivian Hawk IIs are likely to have been the first Hawks of any air force to see combat, gaining air superiority over Paraguay's air force when the two countries squared off in the Gran Chaco War during the early 1930s.

Model 75

Curtiss had not delivered a fighter to the US Army in more than two years when the Air Corps announced a design competition in the fall of 1934 for a new aircraft that would usher in the modern era of single-seat military fighters. The Army's standard fighter at the time was the Boeing P-26, a diminutive low-wing monoplane dubbed the "Peashooter." A transitional design, the P-26 featured wire-braced wings, fixed landing gear with bulbous wheel pants, and an open cockpit. Recent advances in aeronautical design dictated that the next Army fighter would be a major step forward in performance, sophistication, and combat capabilities.

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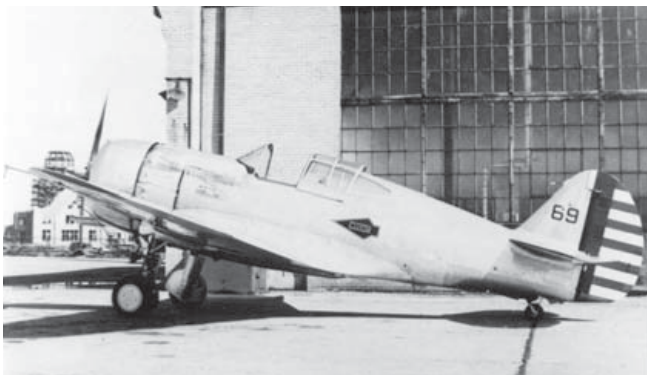

Curtiss delivered Y1P-36 serial number 37-069 to Wright Field on March 17, 1937, for testing. Derived from the prototype Hawk 75, the Y1P-36 was powered by a Pratt & Whitney R-1830 Twin Wasp engine that gave it a top speed of just over 300mph. (Tom Ivie)

The Army specifications called for its new fighter to be an all-metal, low-wing monoplane capable of flying at 300mph. A fly-off among competing designs was set for May 27, 1935, at Wright Field in Ohio, so time was of the essence in developing the new plane.

Curtiss brought in a new chief designer to jump-start the development of its new fighter. Donovan R. Berlin joined the company in October 1934 with 13 years of experience in the aircraft industry. Berlin's first job after graduating from Purdue University with a bachelor of science degree in mechanical engineering was operating the wind tunnel at McCook Field, the Army Air Service's research and experimental test center at Dayton, Ohio. It was there in September 1924 that Berlin got his first exposure to the Curtiss Hawk, when the XPW-8A was tested against the Boeing XPW-9.

Berlin left McCook Field two years later to work for Douglas Aircraft Company as an engineer. There he helped design Douglas observation planes and a flying boat before he was chosen as project engineer on the T2D torpedo plane. His last job with Douglas was chief production design engineer. From there, he went to work in 1929 for Northrop, where he did pioneering work in stressed-skin aluminum construction for the ultra-modern Alpha, Beta, and Gamma series. He was serving as chief engineer when Northrop fired him in 1934 in a dispute over a new wing design. Though Berlin found himself jobless at the depth of the Great Depression, he was out of work for just three months before Ralph S. Damon, president of Curtiss-Wright Corporation, hired him as project engineer for the new Curtiss fighter, soon to be known as the Hawk Model 75.

Berlin quickly moved to Curtiss headquarters in Buffalo, New York, and went to work, knowing he had just seven months to produce a flying prototype for the Army competition. Decades later, he recalled to author Joe Christy how he designed "stretch" into the airframe that would allow it to accommodate high-horsepower engines that were not yet developed. Specifically, he wanted to provide adequate wingspan and area to ensure excellent flight characteristics at 25,000ft and above. Berlin went on:

> In the early stages, I spent a lot of time in the wind tunnel with a one-sixth scale model. In my study of other fighters, past and contemporary, I noted their deficiencies and determined to correct those things in the Model 75. In the wind tunnel,

B

P-40 LONG NOSE ENGINE CONTOURS

If ever the design of a military aircraft and a distinctive unit marking were made for one another, it was the application of a shark's face to the nose of the early P-40/Tomahawk. The origin of this design is credited to George Staly, an engine fitter in 112 Squadron RAF in North Africa, who was the first person to paint a shark on a Tomahawk. Then the rest of the pilots wanted the same, and the "Shark Squadron" was born. Photos of a 112 Tomahawk published in the *London Illustrated News* in 1941 prompted the American Volunteer Group, then forming in Burma with Tomahawks, to adopt the same shark-mouth design. When news of the successes of the Shark Squadron and the AVG began to spread in 1942, shark mouths were painted on P-40s in virtually every theater.

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I developed control surfaces that provided satisfactory characteristics of stability and maneuverability. I drew upon past experience to determine the degree of dihedral and the location and arrangement of the tail surfaces. And I wanted the horizontal tail as high up on the fuselage as I could get it to give as much vertical surface below it as possible for effective spin control, for better protection against rocks thrown back by the propeller and at the same time to keep it high enough above the wing so that it would not be disturbed by turbulence from the split flaps.

Another essential consideration in regard to maneuverability was that the aspect ratio, taper ratio, span loading and wing tip design be such that the plane would be capable of violent maneuvers at high altitudes without squashing or rolling out of tight turns resulting from wing tip stalling. The elimination of wing tip stalling was also essential at the time of landing and flight at very low speeds.

You might say that I practically designed the wing in the Curtiss-Wright wind tunnel in order to get the flight characteristics I wanted throughout the speed ranges I anticipated for the power then available, and for the much greater power that I expected to come. I used the NACA 2215 airfoil section at the root, tapering to 2209 at the tip; and I designed it to be exceptionally rigid to prevent flutter at high speeds.

("Hawkman," *Wings* magazine February 1973, pp. 32–33)

The Hawk 75's structure was all-metal, with metal skin on all but the moveable control surfaces, which were covered with fabric. The fuselage was semi-monocoque construction, built in halves and joined after internal components had been installed. A sliding canopy with minimal metal bracing provided a smooth airflow while also giving the pilot reasonably good visibility out of the cockpit. A metal skid under the belly minimized damage in the case of a wheels-up landing. The plane also was designed for ease of maintenance: everything forward of the firewall could be changed in 14 work hours.

The wing featured hydraulically-operated spit flaps in the trailing edge, inboard from the ailerons. The wings also held the retractable undercarriage. This unusual design featured a single strut under each wing that rotated aft roughly 90 degrees while also pivoting around its axis to turn the wheel 90 degrees so it could lie flat in the thinner aft portion of the wing.

To power the Hawk 75, Curtiss instructed Berlin to use the experimental Wright R-1670, a twin-row 14-cyclinder radial rated at 900hp. Berlin was unimpressed with the new engine and designed the Hawk 75 so the powerplant could be replaced with a minimum of trouble. Events would soon show the wisdom of Berlin's decision.

Curtiss rolled out the prototype Hawk 75 in mid-April 1935. The trim fighter, finished with a blue fuselage and yellow wings and tail, carried its civil registration number X17Y in black on the rudder. Donovan recalled that the plane flew unusually well right out of the box. The only aerodynamic change it needed was a small increase in rudder area to improve yaw control near the stall. However, the R-1670 engine was unreliable, showing a nasty propensity for chewing up its bearings.

This 1940 photo shows a P-36A of the 18th PS/35th PG, likely at Moffett Field, California. The P-36 was the best American fighter of the period, easy to maintain and delightful to fly, with no vices. (Tom Ivie)

Despite its weak engine, the Hawk 75 conceivably could have flown in the May 1935 fighter competition. Seversky Aircraft Company was proposing a fighter version of its two-seat amphibian, Chance Vought's V-141 was an

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improved version of the Northrop Model 3A, and Consolidated was converting its PB-2A two-seat fighter to a single-seater. However, it turned out none of the other competitors was ready, so the Army granted a three-month delay. Problems dogged the competitors again in August, so the trials were rescheduled for April 1936. Curtiss used the extra time to replace the Hawk 75's twin-row engine with a nine-cylinder, single-row R-1820 Wright Cyclone of 850hp.

The 1936 trials were a disappointment for Curtiss. Though the flying characteristics of the Hawk 75 were well received, the new engine failed to produce full power, and the Army judged the Seversky SEV-1XP the winner. The Army ordered 77 production models of the winning fighter, designated the P-35, from Seversky. However, the evaluators were sufficiently impressed by the Hawk 75 to order three service test versions powered by the new 1,050hp Pratt & Whitney R-1830-13 Twin Wasp.

In Army parlance, the new Curtiss fighter would be the Y1P-36. Testing revealed superior performance to the P-35, with a top speed of 300mph, initial climb of 2,100 feet per minute, a service ceiling of 33,200ft, and a range of 885 miles. When the Army held its next fighter competition in May 1937 at Wright Field, the Y1P-36 was the clear winner. On June 6, 1937, the Army Air Corps ordered 210 P-36s from Curtiss, the largest US fighter purchase since World War I.

The United States was not the only country buying fighter planes in 1937. The civil war in Spain provided a preview of future aggression by fascist Germany and Italy, while Japan's advances in China threatened stability in Asia. Air forces were bulking up worldwide, and fighter development was a high priority for most. But when the International Air Meet opened in Zurich in July that year, the best fighter France could show was the Dewoitine 510, a fixed-gear, externally braced monoplane barely capable of 250mph. The 510 was thoroughly outclassed by Germany's Bf 109B, and French leaders knew their domestic aircraft manufacturers were several years away from introducing superior fighters in large numbers. To close the gap in a hurry, the French made arrangements to buy 100 Hawk 75s, and that number eventually grew to more than 250. Other buyers followed, including Argentina, China, Great Britain, India, Iran, Norway, Dutch East Indies, Peru, and Thailand.

Though the first production P-36s met the Army's requirement for a top speed of 300mph, reports from Europe of considerably higher performance by British and German fighters suggested the Army had set the bar too low. Almost immediately, Curtiss engineers began searching for ways to squeeze more speed out of the airframe. The first Y1P-36 was fitted with a four-bladed propeller and later with co-axial props, but neither experiment produced a substantial improvement in speed. Curtiss also tried installing a turbocharger on a company-owned demonstrator, NX-22028, but the bearings in its R-1830-19 Twin Wasp engine could not stand up to high temperatures and the turbocharger was unreliable, so it was removed after testing.

One time-honored means of boosting speed is adding more power, and Curtiss was able to succeed at this by a third over the course of

A P-36A of the 27th PS/1st PG banks over the Ohio landscape during the 1939 National Air Races. The plane displays an experimental segmented camouflage pattern in washable paint, easily removed after the races. Each plane in the squadron had a different camouflage pattern. (Tom Ivie)

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The first attempt by Curtiss to mate the Hawk 75 airframe with the new Allison V-1710 inline engine produced the unsuccessful P-37. Here, one of the 13 YP-37s undergoes cold weather testing in Alaska. It has a red nose and wing panels for visibility in case of a forced landing. (Jack Cook)

production – from 900hp in the prototype Hawk 75 to 1,200hp in the P-36A/P-36C. Streamlining also can boost speed, and Curtiss tried this as well. A P-36A airframe with a Twin Wasp engine was modified in 1939 with a tight cowling over the front of the engine to meet a pointed propeller spinner. An extension shaft connected the propeller to the engine, and a small scoop under the nose was supposed to provide tunnel cooling. The plane was considered different enough from the P-36 to merit its own designation, the XP-42 (Curtiss Model 75S). Unfortunately, the cowling only raised the top speed to 315mph, and it also created a serious cooling problem. A later modification to the XP-42 boosted its speed to 343mph, but by this time (May 1941) the production P-40 already was flying faster than that.

A more radical modification in search of speed was the Model 75I, Army designation XP-37. This was the first attempt by Curtiss to replace the radial engine of the P-36 with the new Allison V-1710, a liquid-cooled, 12-cylinder engine, fitted with a General Electric turbo-supercharger. The Army was quite enamored with this engine and with the prospect of boosting its altitude performance with turbocharging, and rightly so. In time, their confidence in both units would pay off in the form of the high-performance Lockheed P-38 Lightning. But in 1937 neither the engine nor the turbo were sufficiently developed to be suitable for military operations.

The new engine package in the XP-37 gave it a longer nose than the P-36, which necessitated moving the cockpit aft to maintain the proper center of gravity. Pilots immediately complained of problems seeing out of the plane, especially during taxiing when the nose and wing completely blanked out forward vision. But the big problem was the turbocharging. Metallurgy had not yet advanced enough to make a turbine wheel that could stand up to the high speeds it needed to turn, which caused it to break up. In addition, the early turbochargers had manual controls, which required the pilot to monitor engine gauges and adjust the turbo's controls accordingly. This obviously would be impractical for a pilot in combat, when all his attention needed to be directed outside the cockpit. But when everything was working properly, the XP-37 demonstrated the ability to reach 340mph at 20,000ft.

Though the XP-37 was judged promising enough for the Army to order 13 service test YP-37s, it ultimately failed due to these reliability problems. It did, however, show the way for Curtiss's next attempt to wring more speed out of the Hawk 75.

Model 81

On October 14, 1938, a shiny new Hawk rolled out of the Curtiss plant in Buffalo. Designer Donovan Berlin's latest brainchild, this experimental model differed from those that came before. Its pointed nose resembled the XP-37, but from the firewall back it was all P-36. In fact, the new plane had started life as P-36A serial number 38-10. Under the cowling was an Allison V-1710, but unlike the engine in the XP-37, this Allison was fitted with mechanical supercharging instead of the unreliable turbocharger. Curtiss

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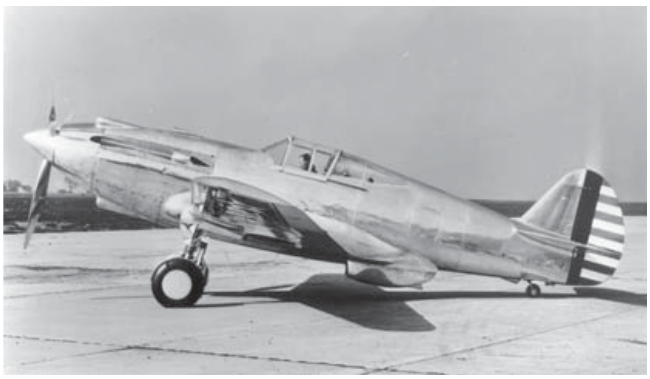
called its new fighter the Hawk 75P (soon changed to Hawk 81), and the Army had already designated it the XP-40.

Edward Elliott, assistant chief test pilot at Curtiss, strapped into the XP-40, fired the engine and taxied out to make the plane's initial flight. On the takeoff roll, Edwards became the first of thousands of pilots to encounter the plane's pronounced nose swing, the unfortunate result of combining a long nose with a relatively narrow main landing gear track in the design. If the new fighter felt less lively to Edwards than the P-36A during climbout, that was because its rate of climb was nearly a third slower than its predecessor. Even more troubling, Edwards was only able to coax the new plane to a top speed of 299mph in level flight at the optimum altitude of 12,000ft. On the plus side, the XP-40 appeared to retain a good measure of the P-36's excellent maneuverability, and it would dive like a demon.



When the XP-40 rolled out for testing in July 1938, the radiator was mounted under its belly to give the plane a bullet-shaped nose. The radiator was moved forward in time for the January 1939 fighter competition at the insistence of the Curtiss-Wright marketing department, according to designer Donovan Berlin. (Craig Busby)

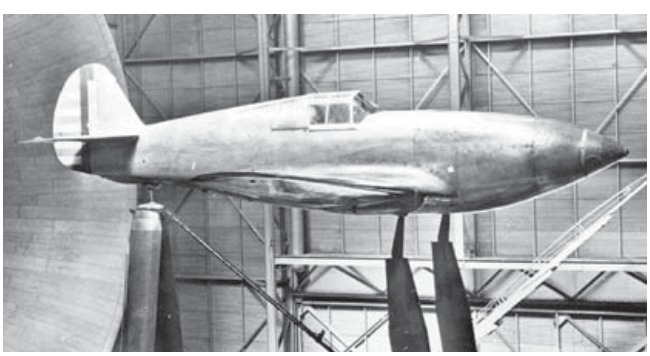
Next to fly the XP-40 was USAAC Fighter Projects Officer Lieutenant Benjamin S. Kelsey. His test produced only slightly better results for the all-important top speed, as he covered some 300 miles in 57 minutes, approximately 315mph. It was clear that Berlin and the engineering team at Curtiss had a lot of work to do before the XP-40 would be suitable for Army service.

Berlin had first envisioned the P-40 in early 1938 when the US Army Air Corps announced a new pursuit competition, with a call for bids on January 25, 1939. The specifications called for a fighter with top speeds of 310 to 370mph to be reached at 15,000ft, with a two-hour endurance at cruising speed.

At this point in time, tensions were already rising in Europe and the Far East. Though isolationist sentiment remained high in the United States, Congress had appropriated funds for a major buildup of the nation's military forces, including the acquisition of a large number of new fighter aircraft. The Army command realized the 1939 fighter would be a stop-gap measure to allow a rapid buildup of its pursuit forces while more advanced aircraft were being developed.

At the same time, the requirement for top performance at the relatively low altitude of 15,000ft revealed a lot about the Army's attitude toward pursuit aviation. Though the prevailing mantra of fighter pilots since the earliest days of air combat called for maintaining an altitude advantage when engaging the enemy ("beware of the Hun in the sun"), the Air Corps command was made up primarily of bomber advocates who saw pursuit through a very narrow prism. The prevailing assumption in the upper ranks was that heavy bombardment aircraft would carry the offensive to the enemy, and fighters would play a secondary role by providing air defense for ground forces on the battlefront and, if necessary, defend

Because the XP-40 had failed to produce the Army's desired top speed of 360mph, the plane was sent to the NACA wind tunnel at Langley, Virginia, for further testing. This sleek but impossible version contained no openings for intake or exhaust. (Craig Busby)



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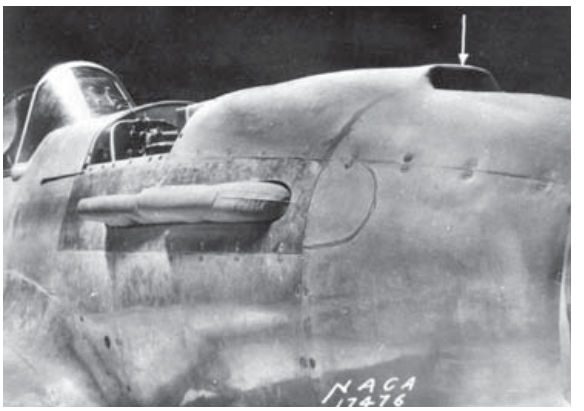

This wind-tunnel modification opened an air intake for the carburetor plus exhaust manifolds. These items would be modified in the eventual production version of the P-40, which featured a long, circular scoop atop the cowling that would feed the carburetor with a ram-air effect. (Craig Busby)

home front targets in the United States. They did not foresee a day when escorting fighters would need to range ahead of and above high-flying Army bombers to protect them from enemy interceptors. This lack of vision would prove tragically costly a few years later when their Flying Fortresses and Liberators confronted the Luftwaffe in the skies over occupied Europe.

Berlin could not concern himself with these matters, however. Curtiss was in the business of selling airplanes, and if the Army command wanted a fighter with top performance at 15,000ft, that was what Berlin would give them. He devised a simple plan for winning the 1939 fighter bid. Since Curtiss already had the excellent Hawk 75 airframe with "stretch" to handle different powerplants, he could mate the 75 to a simplified version of the same Allison V-1710 that he had used for the XP-37. He knew that the Army favored using the inline Allison for fighters because it offered advantages in streamlining over radial engines, but could the Allison produce enough power to produce a 370mph Hawk? After checking with Allison and learning the V-1710 could produce 1,050hp at 15,000ft by stepping up the speed of its integral gear-driven supercharger, Berlin pitched his new fighter project to the Army in a proposal to the Material Division dated March 3, 1938.

Curtiss soon received word that the Army was interested in Berlin's idea, and by July 1938 the Army issued an official order for Curtiss to build the prototype XP-40. The new plane featured an Allison V-1710-19 engine that developed 1,160hp at takeoff. The carburetor drew air from a low scoop on the upper cowling at the rear of the engine, and the exhaust exited through manifolds that bulged the cowling on both sides. A small air intake for the oil cooler was located below the pointed nose, and housings for two machine-gun barrels were forward of the carburetor scoop on top of the cowling. The radiator was mounted in a scoop on the belly behind the trailing edge of the wing, a location that Berlin felt was ideal for weight distribution. It was this aircraft that Edwards and Kelsey tested just three months later with such disappointing results.

The Curtiss design team went back to work on the XP-40, searching for more speed. The engine's exhaust manifolds were replaced by short exhaust stacks exiting straight out of the cowling. The carburetor air scoop was completely redesigned, moving forward on top of the cowling with a circular cross-section to create a ram-air effect. Other minor changes included longer landing-gear legs to provide ground clearance for the propeller and beefed-up wing structure.

Most controversial was the decision to move the radiator forward and tuck it up under the engine in the nose. Doing this allowed the oil cooler and the radiator to draw air from a single opening, which cleaned up the airframe. Berlin, however, claimed this change was forced on him by the Curtiss-Wright Sales and Contract Division to improve the looks of the aircraft and had a negative effect on the P-40's performance throughout its service life.

There is another side to the story, however, because in one way the radiator change actually improved the combat effectiveness of the P-40.

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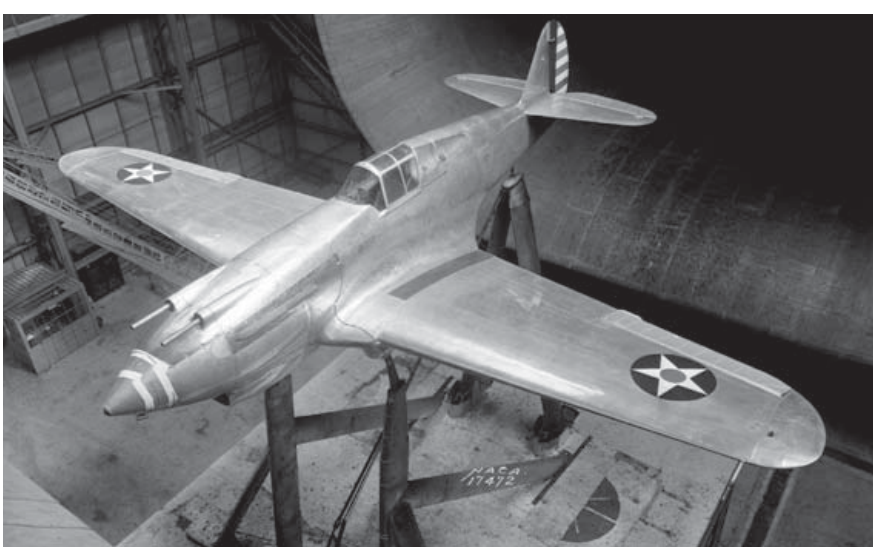
Grouping all the vulnerable parts in the nose made the plane a smaller target for enemy fire. This did not become obvious until the North American P-51/A-36 Mustang, with its belly-mounted cooling system, began to fly ground-attack missions in 1943. The Mustang was much faster than the P-40, but some pilots flying fighter-bomber missions said they preferred the P-40 because it was less likely to be shot down by ground fire.

Cleaning up the XP-40's airframe improved the plane's top speed to 342mph at the specified altitude. When the fighter competition took place at Wright Field in January 1939, the XP-40 won easily over the Hawk 75R that Curtiss also proposed, plus the Seversky AP-4 and AP-9A, all of which had radial engines. Two other proposed fighters, the Lockheed XP-38 and Bell XP-39, featured turbocharged Allison engines, but these were not considered sufficiently developed to warrant production contracts. The Army issued a record-setting contract to Curtiss on April 26, 1939, for 524 P-40s at a cost of nearly $13 million. Though the XP-40 had yet to satisfy the desired performance specifications set out by the Army, the low price and quick availability of the new Curtiss fighter had carried the day. More advanced designs, especially the P-38, promised speed and altitude performance far superior to the P-40, but their manufacturers would require at least two years before they could begin delivering them to the Army. Deliveries of the P-40 could start in half that time, allowing the USAAC to embark on its buildup while Lockheed and other manufacturers developed the next generation of American fighters.

The Army chose to skip the option of ordering Y-prefixed service test aircraft and went directly to the P-40 production model. Designated by Curtiss as the Hawk 81, the production model featured the dash-33 Allison engine and carried four machine guns – two .50-caliber weapons in the upper cowling and one .30-caliber gun in each wing. Meanwhile, the Curtiss engineers, having guaranteed to the Army that the top speed of the production P-40 would be 360mph at 15,000ft, continued to massage the design in the quest for more speed.

The XP-40 was shipped to the wind tunnel at the National Advisory Committee for Aeronautics' (NACA) Langley Memorial Aeronautical Laboratory, Langley Field, Virginia. Wind-tunnel tests were seeking a top



Fairings for the fuselage machine guns and the radiator intake under the nose are visible in this handsome wind-tunnel view of the XP-40. Modifications eventually yielded a top speed of 357mph for the P-40-CU. (Craig Busby)

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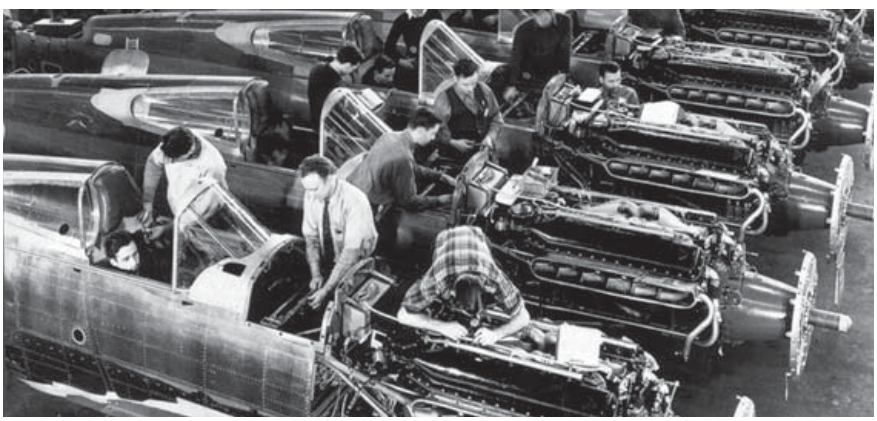
The first three production P-40-CUs, all in natural metal finish, went to Wright Field, Ohio, for official USAAC testing. The remainder of the 199 P-40-CUs were delivered in the Army's new camouflage scheme of dark olive drab No. 41 over neutral gray No. 43. (Craig Busby)

speed of 370mph at 16,000ft. A report issued by NACA on May 16, 1939, included the following excerpt:

> At the request of the Army Air Corps Material Division, the XP-40 airplane was tested in the NACA full-scale wind tunnel to investigate methods for increasing the maximum speed ... The greatest emphasis during the test was directed toward reducing the drag of the radiator installation without decreasing the quantity of air flowing through the radiator ... Based on the test results, it is estimated that modifications to the airplane that are immediately practicable such as sealing slots, utilizing trailing antenna, closing spinner holes, fairing landing gear, and modifying the radiator installation would increase top speed by about 23 miles per hour. Incorporating the further refinements of completely retracting the landing gear, increasing the size of the radiator and providing an optimum radiator duct, smoothing the wing, redesigning the oil-cooler system so as to obtain a higher duct efficiency, and improving the wing fillets could result in a total increase in maximum speed of about 42 miles per hour… It is believed an optimum design of the carburetor inlet would consist of a single scoop, similar to the modified one used in the present tests, but with its opening farther forward to avoid the loss in ram pressure due to the fuselage boundary layer.

As a result of further changes, the modified XP-40 reached 366mph at the desired altitude in December 1939, satisfying the Army that the P-40 was sufficiently developed to go into mass production.



Production workers assemble P-40 fuselages in one of the two Curtiss-Wright Airplane Division plants in Buffalo, New York. Note how the design of the engine's reduction gear housing defines the shape of the P-40 nose. (Craig Busby)

C

EARLY HAWKS

1: The father of the P-40 was the Curtiss Hawk 75 prototype, which first flew in mid-April 1935. Its experimental twin-row Wright R-1670 engine was a disappointment and soon gave way to the single-row R-1820 Wright Cyclone.
2: The first attempt by Curtiss to mate the Hawk 75 airframe with an Allison V-1710 liquid-cooled V-12 produced the XP-37. The engine's under-developed turbocharging system and the awkward cockpit position doomed the design.
3: The XP-42 was an attempt to add speed to the P-36 by fitting a streamlined cowling around its Cyclone engine. The speed gain was negligible, but the cowling did produce serious cooling problems.
4: In March 1938, Curtiss designer Donovan R. Berlin proposed mating the P-36 with an Allison V-1710 equipped with a gear-driven supercharger to create the XP-40. Note the aft belly position of the radiator, which subsequently was moved to the nose.

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In January 1939, the modified version of the XP-40 won the Army contract to build 524 production P-40s for $12.9 million. This was the largest US peacetime contract for a pursuit aircraft awarded up to that time. (Craig Busby) [AVG008_015]

The first production P-40-CU (the CU suffix indicated aircraft built in Curtiss' Buffalo facilities), serial number 39-156, rolled off the Curtiss production line in March 1940. That plane, along with the next two off the line, went through a series of tests that determined its top speed was 357mph at 15,000ft, its cruising speed was 277mph, and its landing speed was 80mph. The P-40's service ceiling was 32,750ft, and it could climb 3,080ft during the first minute of flight, reaching 15,000ft in 5.3 minutes. Deliveries of the first 200 P-40s to the Army began in June 1940. A further 390 P-40-CUs on order were canceled in favor of more advanced models.

Curtiss also began producing an export version of the Hawk 81, the Tomahawk. France had been the first country to place an order, but none of the 185 H-81-A1s it ordered in May 1939 had been delivered before that nation fell to Germany a year later. Great Britain was by then desperate to obtain additional fighters for the RAF and took over the French order, along with placing its own order for Tomahawks.

Sources disagree whether Curtiss produced a P-40A or not, but the first significant upgrade to the line was the P-40B-CU, or H-81-A2. The changes in this model were the product of intelligence gleaned from the air battles that took place during the first year of war in Europe. They included refinements such as self-sealing fuel tanks, armor protection for the pilot behind the seat and in the windshield, and the addition of a second .30-caliber machine gun in each wing. This aircraft, with .303-caliber machine guns in the wings, became the Tomahawk IIA in RAF service.

New self-sealing tanks were introduced in the P-40C-CU (Tomahawk IIB in the RAF, again with .303-caliber wing guns). These reduced the internal fuel capacity from 160 gallons to 135, so the provision for carrying an external 52-gallon drop tank on the centerline was added on the P-40C to compensate. An SCR-247N radio replaced the SCR-283 of the earlier P-40s. Each of these items added weight, and the performance of the new models – particularly their rate of climb – suffered accordingly. However, these were the first models of the P-40 to be fully combat-capable.

TECHNICAL SPECIFICATIONS

As we have seen, the Curtiss Hawk H-81/P-40 series was a marriage of convenience that worked remarkably well. The two partners were the Hawk 75 airframe and the Allison V-1710 engine, both of which remained basically unchanged through the three phases of the series. But this was a wartime marriage, after all, with inherent challenges arising from lessons learned on the field of battle.

Initial testing of the prototype XP-40 revealed it to be far slower than the US Army Air Corps' preferred top speed of 370 miles per hour. So the first job for designer Donovan Berlin and his engineering team was to massage the XP-40 in search of more speed. This work produced the first production

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model, P-40-CU, which was the fastest long-nosed Hawk with a top speed of 357 miles per hour.

Though the P-40-CU did not reach its speed goal, the Army was satisfied that it came close enough. The USAAC needed a new fighter to replace its obsolescent P-35s and P-36s, and Curtiss was in a position to deliver the P-40 at least a year sooner than any of its competitors could place their designs in production. But the P-40-CU was a show horse, only useful for training pilots, flying public relations formations, and participating in war games. By the time it began equipping USAAC squadrons in spring 1940, the air war in Europe was already revealing that a fighter with just four guns and without protective armor for the pilot or self-sealing fuel tanks to prevent fire had no place in the modern combat environment.

With each order for a new version of the H-81 came additional requirements expected to make the plane more combat capable. There is no doubt that the equipment specified – additional guns, armor protection, better radios, and more – was justified. But there was a price to pay as the P-40 became increasingly loaded down. That price was performance, which had been an issue since the first flight of the XP-40.

Though the powerful engine and streamlined nose of the H-81 gave it a higher top speed than that of the H-75, the growing weight of the newer fighter had a negative effect on other key elements of performance, particularly climb rate and maneuverability. The wing area of the two planes remained constant at 236 square feet, but the gross weight rose from 5,418 pounds in the H-75 prototype to 7,549 pounds in the P-40C. As a result, the wing loading grew accordingly from 22.9 pounds per square foot in the H-75 prototype to 31 pounds per square foot in the P-40C, a 35 percent change. It is little wonder that pilots transitioning from the lively H-75 to the supposedly superior H-81 tended to be sorely disappointed by the experience.

Personal Perspectives

Bruce K. Holloway was the top USAAF P-40 fighter ace to survive the war, credited with 13 victories while flying with the 23rd Fighter Group in China during 1942 and 1943. He recalled his first impression of the P-40, gained as a young captain in the months before the US entered the war:

> The P-40 was not a spectacular performer. It was, however, except for the very early models, a rugged, simple, reliable aircraft which would take more punishment and get home safely than any other fighter of its era except possibly the P-47. The first encounter I had with this venerable machine was the P-40 "blank" at Wright Field in the summer of 1941. It was truly a blank, and on a couple of rare occasions when it was in commission I was allowed to fly it. From the firewall back it was essentially identical to the P-36. However, it had less power than the P-36, was about 2,500 pounds heavier, aerodynamically less stable, had about half the rate of climb, 7,000 or 8,000 feet less service ceiling, slightly more range and possibly a few mph more speed under ideal conditions.
>
> I don't recall there was any armament in this first model, which I believe had an "X" designation, but the P-40B had six guns. This was three times as many as the P-36, but they were not very reliable. There were two .30-caliber guns in each wing, and two .50-calibers

This view clearly shows how Curtiss married the Hawk 75 airframe and the Allison V-1710 engine to produce the XP-40. This approach allowed Curtiss to deliver a new fighter at least a year quicker than its rivals for the 1939 pursuit contract. (Craig Busby)

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Bruce K. Holloway, leading American P-40 ace with 13 confirmed victories over China in 1942–43, was not impressed when he first flew the P-40-CU at Wright Field in 1941. He considered its performance no improvement over the P-36. But in combat he came to value the later P-40s' sturdy airframe, reliable engine, and heavy firepower.

firing through the propeller. All of them had mechanical cable rechargers, which was fortunate because jamming varied between often and systematic. There was a small centerline bomb rack [on the P-40C] which would carry a few 30-pound bombs or a small drop tank.

After this first experience, to which my general reaction was "why bother," it was nearly a year before the P-40 and I met again – in China ... I have mentioned previously that one of the big plus factors for the P-40 was its ruggedness. It was really a tough bird. I have personally seen 450 mph indicated on the gauge in dives, and I've never heard of a P-40 coming apart. The P-40 terminal velocity was not quite high enough to encounter noticeable local compressibility phenomena, but it was great enough to run out of enough leg power on the rudder to keep the ball in the middle. In view of this, it was surprising to me that the canopies did not come off at terminal speed. The locking mechanism was not like that of the bubble canopies of later model Jugs and Mustangs, but just the plain old sliding type with crank and cable operation, with fresh air cracks along the track. It was ruggedly built like the rest of the airplane.

John Alison, a fighter pilot and leader whose skill and courage were second to none, came back for an encounter with several Japanese fighters in as shot-up a condition for still being airborne as I have ever seen. The airplane looked like a bunch of fire-sale spare parts flying along in formation. The whole fuselage back of the cockpit was riddled, part of the engine cowling was gone, only a rag was left of what once was a rudder, and one elevator was completely missing (with the other one looking pretty limp). As I recall, he had no brakes or flaps, but the engine still ran, and he got her down well enough to walk away. It was a stirring sight, the kind of thing that prevented anyone who flew the P-40 in combat from ever damning this airplane in spite of its rather marked deficiencies in performance.

The engine, too, was essentially as tough as the airframe. One of the things that got so many wounded P-40s back – and would have helped many a doomed P-51– was coolant location. Both engine and oil radiators were up front, with commensurately short interconnecting lines. Almost all small-arms ground fire had a tendency not to lead low-flying aircraft enough, so the hit pattern was usually in the aft section of the aircraft. The P-51, with its aft radiators and long connecting lines, was thus more vulnerable to ground fire than the P-40, though this was about its only significant weakness.

The Allison V-1710 engine was just plain sturdy. Its power output was never raised to anywhere near the levels of the Merlin 1650. Accordingly, bearings were conservatively stressed and rarely gave any trouble even under emergency or wounded conditions. Once, while strafing trucks, I received a shot in the scavenge oil pump and immediately lost all oil pressure. I reduced power to a low setting, and the engine ran for nearly four minutes with no oil! This was enough to get me back over friendly territory and sit her down (with a few convolutions through several rice paddy dikes) pretty much in one piece. A post-mortem, as best I could conduct it, showed that even so, failure occurred in the reduction gear box rather than the engine proper – a finding which tallies with the fact that an internal engine failure probably would have resulted in a fire.

D

UK-BASED TOMAHAWK, 1941–42

Tomahawk IIs, the first combat-capable Hawk 81s delivered to the RAF, began to arrive in England in the winter of 1940–41. One of the first units to receive them was No. 403 Squadron RCAF, formed at Baginton in March 1941. The squadron became operational on May 11, 1941, when Squadron Leader B. O. Morris and Pilot Officer K. H. Anthony carried out a patrol at 25,000 feet. No. 403 went on to fly 29 operational sorties by the end of May, mostly scrambles, but without incident. The squadron re-equipped with Spitfires on June 11, 1941. The 403 Squadron Tomahawks wore standard Fighter Command markings of the period and were camouflaged in Curtiss equivalents of RAF dark earth and dark green over sky gray.

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In 300 hours of combat flying, the only problems I had with the 1710 other than enemy action were a broken throttle linkage (fortunately near the airfield) and a sheared distributor rotor. This was in spite of a fair amount of operation well over red-line limitations. The sheared rotor creates a rather frightening condition, with random firing of the engine as the rotor debris makes contact with the pins while sloshing around in the distributor cap. The best description is one of a convulsive engine without appreciable power and with fire occasionally shooting out of the intake scoop behind the prop. It scared me plenty, but again I managed to get into the field.

Among P-40 pilots of the British Commonwealth, Holloway's counterpart as top-scoring ace was Australian Clive R. "Killer" Caldwell, credited with 20.5 victories while flying Tomahawks and Kittyhawks in North Africa with RAF 250 Squadron and 112 Squadron. He gave this account to author Geoffrey Pentland:

The Tomahawks were the best the RAF had in the Middle East and I was glad to be flying them, liked their flush-riveted clean lines and the aircraft itself. They were wanting in performance but the Allison engine was honest, hard-working and reliable. ... The aeroplane handled and turned well, gave a fair warning of the approaching stall, recovered from a spin without fuss, and in general had little vice.

In service they proved strong and rugged and would stand up to a lot of punishment from opposing fire as well as from violent aerobatics. They picked up speed quickly in a dive, but at steep angles of dive at high speed, considerable strength of arm and leg and/or a lot of activity with the trim gear was needed to keep control. While inferior in performance, particularly at altitude, to the Bf 109 and the elegant MC 202 Folgore, which latter aircraft appeared in the desert toward the end of 1941 and excited my admiration if not my approval, the Tomahawk seemed to hang on to them well in a steep or vertical dive and, operating within its own altitude limitations, performed creditably in a dogfight. The Tomahawk's lack of comparable performance left the initiative mainly with the opposition and it was usual to accept their initial attack in order to engage at our best height. We rarely caught them below us.

The armament was adequate. The two .50-caliber guns firing through the airscrew were especially useful at close range, and the four .30 wing guns were changed over to .303s to take advantage of more sophisticated ammunition then available. The Tomahawk did, however, have one serious fault. The cockpit canopy, when jettisoned from the near-closed or well forward position, swung inwards through the cockpit, striking the pilot a heavy blow in the face or head. My own experience with this on June 2, 1941, in AK938, from which I was very lucky indeed to recover in time, brought this to light with consequent warning to pilots.

Unlike Holloway and Caldwell, who already were experienced fighter pilots when they first flew the P-40, Sidney W. Brewer was one of the many thousands of young American pilots who were coming out of flight school in the first few months following their nation's entry into World War II. Brewer was fortunate to have been selected to fly a P-35 in the closing days of training, and then he was sent directly to Philadelphia to join the 59th Fighter Squadron of the 33rd Fighter Group in April 1942. Brewer recalled his introduction to the P-40 in his 1997 book, *An Autobiography*. His reaction to flying the fighter for the first time reveals the awe that was born of his inexperience:

I soon made my way to Philadelphia. I arrived by train and somehow made my way out to the airport, only to find the place almost deserted. A couple of Curtiss P-40s

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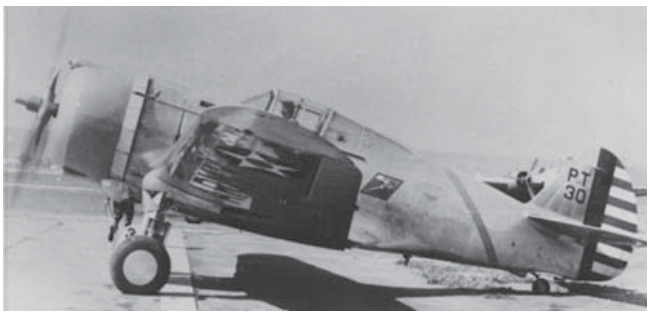
were sitting there, and you can't believe my excitement to see them for the first time and to realize that soon I would be flying the Air Corps' latest and most modern fighter. Other new pilots soon began to arrive, and somehow we learned that the squadron was in Baltimore, Maryland, flying intercept missions from the Glen Martin plant airport. Someone had a car, and we all piled in and took off for Baltimore ...



The 79th PS/20th PG acquired its first aircraft with a closed cockpit, the Curtiss P-36, in September 1938 at Barksdale, Louisiana. Squadron markings include the broad yellow cowling band, the squadron badge, and the flight leader's band on the rear fuselage.

The next few weeks were spent getting settled in at the squadron and studying about the P-40 in preparation to check out. All of us new pilots and a few older ones were sent to Millville, New Jersey, where we lived in tents and started the process of learning to fly that monstrous and wonderful airplane. Since it only had one seat, no experienced pilot could ride with you, so it was a little chat sitting on the wing, a pat on the back and off you go. My previous flights in the P-35 also were without an accompanying pilot, so I sort of knew what to expect. I shall never forget cranking up that engine, feeling all that power, taxiing out to the end of the runway and lining up.

The P-40 had a very long nose that blocked all forward visibility while on the ground taxiing, but once I pushed that throttle full on and with a roar, that ship just leaped forward. As I gained speed the tail lifted so I could see straight ahead, and I roared down the runway and slowly lifted her into the air. There I was, the landing gear coming up, throttling back to climbing power and air speed and realizing I was in control of the most marvelous machine that I could imagine.

What a feeling it was. Never had I flown so fast or felt the power of such a machine. I flew around for a while and then came back and made a nice approach and landing. I had no problem, and I attribute that to the previous flight in the P-35. Too bad that the other fellows had not had that opportunity, for some of them had real problems with the P-40. A couple of fellows had serious problems, and there were several accidents during this transition period. We stayed in New Jersey for about a week or 10 days. I had about eight or 10 flights, I guess, before we went back to Philadelphia to join the squadron.

Brewer was reassigned to the newly forming 324th Fighter Group a few months later and went on to fly 68 combat missions in the Mediterranean theater during 1943 and 1944.

P-40s also earned the respect of the men charged with keeping them in flying condition. One of them was Bob Resconsin, who gave the author this insight in 2003:

I joined the 57th Fighter Group when it was organized at Mitchel Field, New York, coming over from the 8th Pursuit Group at Langley Field. That was in 1941. Originally I was assigned to the 66th Squadron, but was transferred to the 64th after we got overseas and the 64th needed an electrician and instrument man.

I was both an aircraft electrician and instrument mechanic, doing more actual duty as electrician. That was concerning keeping the electrical system, especially the generator system of the P-40s in working order. Many shot-out conduits and wiring had to be replaced as well. Voltage regulators were forever going bad. My most harrowing day as electrician was when I miss-wired a circuit breaker and emptied all the guns while sitting in the revetment. The armorers didn't appreciate that one bit. Instruments gave very little trouble except when shot out. Occasionally a pitot tube would get clogged and need to be blown out.

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Specifications

Army Hawk 75s

Model	75 prototype
Manufacturer	Curtiss-Wright Aeronautical Corporation
Other names	Hawk 75
Aircraft operational role	fighter
Pilot/crew requirement	one pilot
Powerplant	Wright R-1670 (others later)
Rating at altitude	900hp at 10,000ft
RPMs	unknown
Compression ratio	unknown
Propeller	three-bladed
Gross weight	5,418lb
Empty weight	4,506lb
Length	27ft 10.5in.
Airfoil	NACA 2215 at root tapering to NACA 2209 near tips
Wingspan	37ft 3.5in.
Wing area	236sq ft
Wing loading	22.96lb per sq ft
Landing speed	69mph
Max speed at altitude	300mph at 10,000ft
Cruising speed	260mph
Service ceiling	33,200ft
Initial climb	2,100ft per minute
Range	885m
Armament	one .50-caliber machine gun and one .30-caliber machine gun
Gun sight	N2-A
Landing gear	retractable
Production	1, April 1935
Serial number	X17Y

Model	Y1P-36
Manufacturer	Curtiss-Wright Aeronautical Corporation
Other names	Hawk
Aircraft operational role	fighter
Pilot/crew requirement	one pilot
Powerplant	Pratt & Whitney R-1830-13 Twin Wasp
Rating at altitude	1,200hp at takeoff
RPMs	2,700
Compression ratio	6.7:1
Propeller	three-bladed
Gross weight	5,418lb
Empty weight	4,506lb
Length	27ft 10.5in.
Airfoil	NACA 2215 at root tapering to NACA 2209 near tips
Wingspan	37ft 3.5in.
Wing area	236sq ft
Wing loading	22.96lb per sq ft
Landing speed	69mph
Max speed at altitude	300mph at 10,000ft
Cruising speed	256mph
Service ceiling	33,200ft
Initial climb	2,100ft per minute

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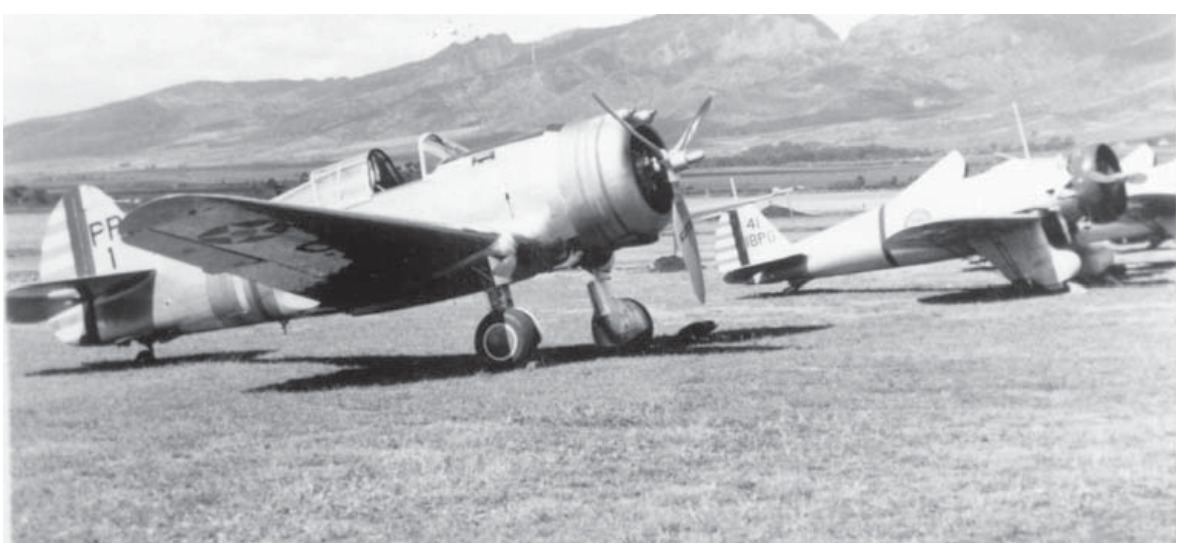
Range	885m
Armament	one .50-caliber machine gun and one .30-caliber machine gun
Gun sight	N2-A
Landing gear	retractable
Production	3, March–April 1937
Serial numbers	37-068, 37-069, 37-070

Model	P-36A
Manufacturer	Curtiss-Wright Aeronautical Corporation
Other names	Hawk 75L
Aircraft operational role	fighter
Pilot/crew requirement	one pilot
Powerplant	Pratt & Whitney R-1830-17 Twin Wasp
Rating at altitude	1,050hp at 6,500ft
RPMs	2,700
Compression ratio	6.7:1
Propeller	three-bladed
Gross weight	5,470lb
Empty weight	4,567lb
Length	28ft 6in.
Airfoil	NACA 2215 at root tapering to NACA 2209 near tips
Wingspan	37ft 3.5in.
Wing area	236sq ft
Wing loading	23.18lb per sq ft
Landing speed	69mph
Max speed at altitude	313mph at 10,000ft
Cruising speed	270mph
Service ceiling	33,700ft
Initial climb	2,600ft per minute
Range	825m
Armament	one .50-caliber machine gun and one .30-caliber machine gun
Gun sight	N2-A
Landing gear	retractable
Production	176, April 1938–March 1939
Serial numbers	38-001; 38-002; 38,003; 38-005 through 009; 38-011 through 019; 38-021 through 084; 38-086 through 180

The 18th PG's first P-36A was assigned to the group commander, Major Ken Walker. Sharing the flightline at Wheeler Field, Hawaii with the brightly marked PR1 in 1940 are Boeing P-26 "Peashooters."



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Model	P-36C
Manufacturer	Curtiss-Wright Aeronautical Corporation
Other names	Hawk 75
Aircraft operational role	fighter
Pilot/crew requirement	one pilot
Powerplant	Pratt & Whitney R-1830-25 Twin Wasp
Rating at altitude	1,050hp at 6,500ft
RPMs	2,700
Compression ratio	6.7:1
Propeller	three-bladed
Gross weight	5,470lb
Empty weight	4,567lb
Length	28ft 6in.
Airfoil	NACA 2215 at root tapering to NACA 2209 near tips
Wingspan	37ft 3.5in.
Wing area	236sq ft
Wing loading	23.18lb per sq ft
Landing speed	69mph
Max speed at altitude	313mph at 10,000ft
Cruising speed	270mph
Service ceiling	33,700ft
Initial climb	2,600ft per minute
Range	825m
Armament	one .50-caliber machine gun and three .30-caliber machine guns
Gun sight	N2-A
Landing gear	retractable
Production	31, April 1939
Serial numbers	38-085; 38-181 through 210

Model	P-36G
Manufacturer	Curtiss-Wright Aeronautical Corporation
Other names	Hawk 75
Aircraft operational role	fighter
Pilot/crew requirement	one pilot
Powerplant	Wright 1820-G5 Cyclone Twin Wasp
Rating at altitude	1,100hp at 5,100ft
RPMs	2,500
Compression ratio	6.5:1
Propeller	three-bladed
Gross weight	5,880lb
Empty weight	4,674lb
Length	28ft 6in.
Airfoil	NACA 2215 at root tapering to NACA 2209 near tips
Wingspan	37ft 3.5in.
Wing area	236sq ft
Wing loading	24.92lb per sq ft
Landing speed	69mph
Max speed at altitude	322mph at 10,000ft
Cruising speed	261mph
Service ceiling	32,350ft
Initial climb	2,600ft per minute
Range	650m
Armament	two .50-caliber machine guns and four .30-caliber machine guns

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Gun sight	N2-A
Landing gear	retractable
Production	30, January 1941
Serial numbers	42-38305 through 322; 42-108995 through 9006

Model	XP-37
Manufacturer	Curtiss-Wright Aeronautical Corporation
Other names	Hawk 75I
Aircraft operational role	fighter
Pilot/crew requirement	one pilot
Powerplant	turbocharged Allison V-1710-C8
Rating at altitude	1,000hp at 20,000ft
RPMs	2,600
Compression ratio	6.65:1
Propeller	three-bladed
Gross weight	6,350lb
Empty weight	5,272lb
Length	29ft 8.5in.
Airfoil	NACA 2215 at root tapering to NACA 2209 near tips
Wingspan	37ft 3.5in.
Wing area	236sq ft
Wing loading	26.91lb per sq ft
Landing speed	75mph
Max speed at altitude	340mph at 10,000ft
Cruising speed	304mph
Service ceiling	35,000ft
Initial climb	2,817ft per minute
Range	625m
Armament	one .50-caliber machine gun and one .30-caliber machine gun
Gun sight	N2-A
Landing gear	retractable
Production	1, February 1937
Serial numbers	38-375

Ground crewmen at Selfridge Field, Michigan, use a rope and cuff to pull through the propeller of P-36C No. 100. The boxes under the wings collected spent shells from the .30-caliber wing guns.

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An unarmed early-production P-40 of the Material Division at Wright Field, Ohio, displays the standard markings of 1940: stars above and below both wings with striped rudder. The significance of the lowered tail wheel is unknown.

Model	XP-42
Manufacturer	Curtiss-Wright Aeronautical Corporation
Other names	Hawk 75S
Aircraft operational role	fighter
Pilot/crew requirement	one pilot
Powerplant	turbocharged R-1830-31 Twin Wasp
Rating at altitude	1,000hp at 14,500ft
RPMs	2,700
Compression ratio	6.7:1
Propeller	three-bladed
Gross weight	5,919lb
Empty weight	4,818lb
Length	30ft 7in.
Airfoil	NACA 2215 at root tapering to NACA 2209 near tips
Wingspan	37ft 3.5in.
Wing area	236sq ft
Wing loading	25.08lb per sq ft
Landing speed	69mph
Max speed at altitude	315mph at 15,000ft
Cruising speed	286mph
Service ceiling	33,000ft
Initial climb	2,600ft per minute
Range	730m
Armament	one .50-caliber machine gun and one .30-caliber machine gun
Gun sight	N2-A
Landing gear	retractable
Production	1, March 1939
Serial numbers	38-4

E

PREWAR USAAC P-40

The 33rd Pursuit Squadron deployed to Iceland in August 1941, flying its 30 P-40Cs off the aircraft carrier USS *Ranger* to its new base at Reykjavik without incident. Sent to enforce Iceland's neutrality in the face of German aggression in the months prior to the US entering World War II, the squadron continued to provide air defense for the island nation throughout the war. Its P-40Cs, along with later model Warhawks, remained operational well into 1944, when the squadron transitioned to P-47s. The P-40Cs displayed very drab Army markings when they arrived in Iceland, but eventually some were adorned with colored propeller spinners, nicknames, and other decorations.

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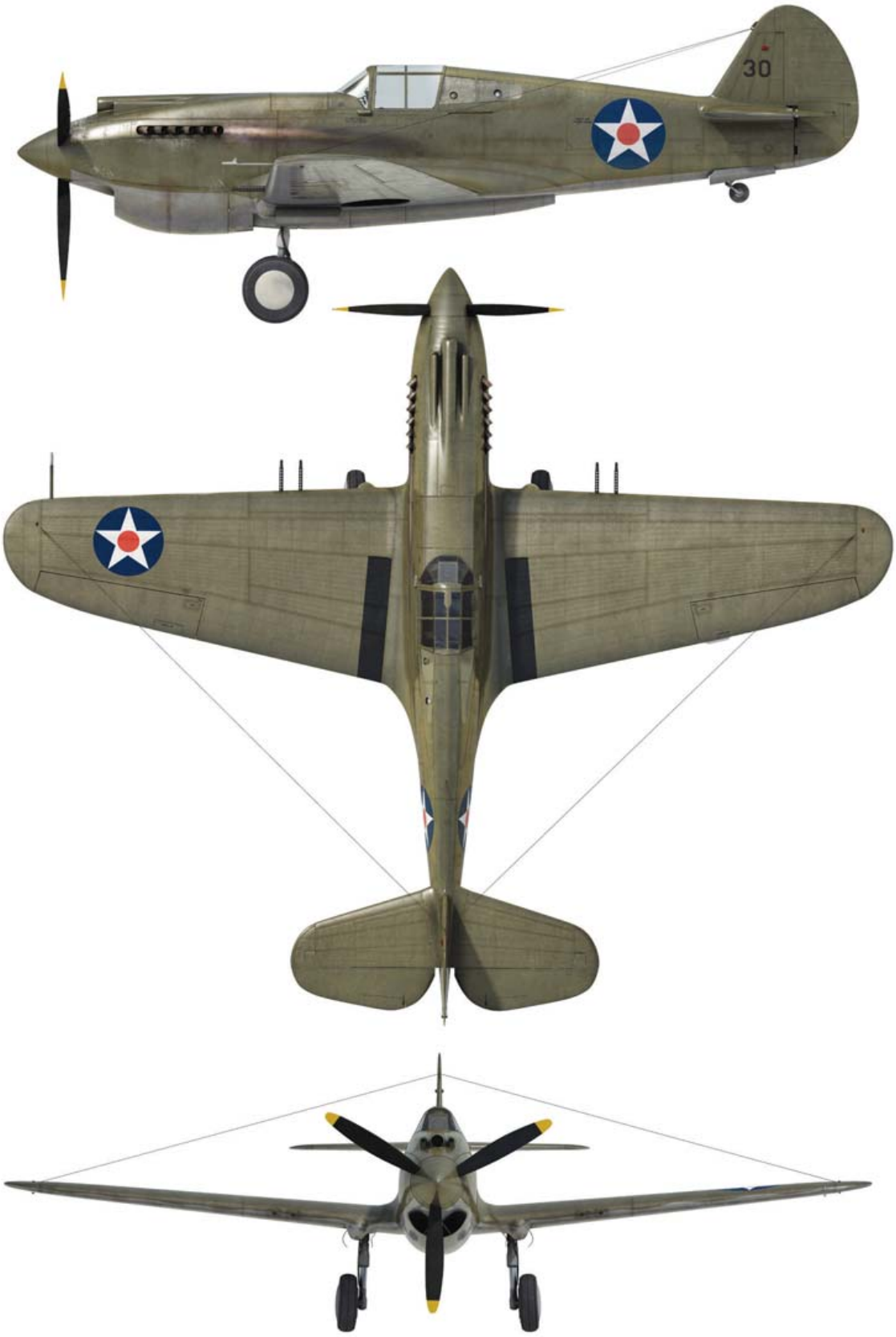

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Export Hawk 75s

Model	H75A-1
Built for	France
Manufacturer	Curtiss-Wright Aeronautical Corporation
Other names	Hawk 75
Aircraft operational role	fighter
Pilot/crew requirement	one pilot
Powerplant	Pratt & Whitney R-1830-SC3-G Twin Wasp
Rating at altitude	900hp at 12,000ft
RPMs	2,550
Compression ratio	6.7:1
Propeller	three-bladed
Gross weight	5,470lb
Empty weight	4,567lb
Length	28ft 6in.
Airfoil	NACA 2215 at root tapering to NACA 2209 near tips
Wingspan	37ft 3.5in.
Wing area	236sq ft
Wing loading	23.18lb per sq ft
Landing speed	69mph
Max speed at altitude	313mph at 10,000ft
Cruising speed	270mph
Service ceiling	33,700ft
Initial climb	2,600ft per minute
Range	825m
Armament	four .30-caliber machine guns
Gun sight	ring and post
Landing gear	retractable
Production	100, December 1938–April 1939
Constructor's numbers	CW 12799 through 12897

Model	H75A-2
Built for	France
Manufacturer	Curtiss-Wright Aeronautical Corporation
Other names	Hawk 75
Aircraft operational role	fighter
Pilot/crew requirement	one pilot
Powerplant	Pratt & Whitney R-1830-SC3-G Twin Wasp
Rating at altitude	900hp at 12,000ft
RPMs	2,550
Compression ratio	6.7:1
Propeller	three-bladed
Gross weight	5,470lb
Empty weight	4,567lb
Length	28ft 6in.
Airfoil	NACA 2215 at root tapering to NACA 2209 near tips
Wingspan	37ft 3.5in.
Wing area	236sq ft
Wing loading	23.18lb per sq ft
Landing speed	69mph
Max speed at altitude	313mph at 10,000ft
Cruising speed	270mph
Service ceiling	33,700ft
Initial climb	2,600ft per minute

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Range	825m
Armament	six .30-caliber machine guns
Gun sight	ring and post
Landing gear	retractable
Production	100, May–July 1939
Constructor's numbers	CW 12932 through 13031

Model	H75A-3
Built for	France, Great Britain
Manufacturer	Curtiss-Wright Aeronautical Corporation
Other names	Mohawk III (RAF)
Aircraft operational role	fighter
Pilot/crew requirement	one pilot
Powerplant	Pratt & Whitney R-1830-S1C3G Twin Wasp
Rating at altitude	1,050hp at 7,500ft
RPMs	2,550
Compression ratio	6.7:1
Propeller	three-bladed
Gross weight	5,692lb
Empty weight	4,483lb
Length	28ft 7in.
Airfoil	NACA 2215 at root tapering to NACA 2209 near tips
Wingspan	37ft 3.5in.
Wing area	236sq ft
Wing loading	24.12lb per sq ft
Landing speed	69mph
Max speed at altitude	311mph at 10,000ft
Cruising speed	270mph
Service ceiling	33,700ft
Initial climb	2,350ft per minute
Range	820m
Armament	six .30-caliber machine guns
Gun sight	ring and post
Landing gear	retractable
Production	100, December 1938–April 1939
Constructor's numbers	CW 12799 through 12897

P-40-CUs were not suitable for combat duty and spent their operational lives in the US for testing and training. This one, serial number 39-280, was decorated with a shark face when photographed in 1942–43. (Tom Ivie)

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Model	H75A-4
Built for	France, Great Britain
Manufacturer	Curtiss-Wright Aeronautical Corporation
Other names	Mohawk IV (RAF)
Aircraft operational role	fighter
Pilot/crew requirement	one pilot
Powerplant	Wright R-1820-G205A Cyclone
Rating at altitude	1,100hp at 5,100ft
RPMs	2,500
Compression ratio	6.5:1
Propeller	three-bladed
Gross weight	5,692lb
Empty weight	4,483lb
Length	28ft 7in.
Airfoil	NACA 2215 at root tapering to NACA 2209 near tips
Wingspan	37ft 3.5in.
Wing area	236sq ft
Wing loading	24.12lb per sq ft
Landing speed	69mph
Max speed at altitude	311mph at 10,000ft
Cruising speed	262mph
Service ceiling	33,700ft
Initial climb	2,350ft per minute
Range	820m
Armament	six .30-caliber machine guns
Gun sight	ring and post
Landing gear	retractable
Production	284, April 1939–August 1940
Constructor's numbers	CW 13806; 13808 through 14090

This handsome example of the P-40-CU was assigned to the 55th PS/20th PG and photographed in California at Oakland Municipal Airport in 1940. The squadron badge is yellow and blue; the spinner is white. (Craig Busby)

Model	H75A-6
Built for	Norway
Manufacturer	Curtiss-Wright Aeronautical Corporation
Other names	Hawk
Aircraft operational role	fighter

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Pilot/crew requirement	one pilot
Powerplant	Pratt & Whitney R-1830-S1C3G Twin Wasp
Rating at altitude	1,050hp at 7,500ft
RPMs	2,550
Compression ratio	6.7:1
Propeller	three-bladed
Gross weight	5,692lb
Empty weight	4,483lb
Length	28ft 7in.
Airfoil	NACA 2215 at root tapering to NACA 2209 near tips
Wingspan	37ft 3.5in.
Wing area	236sq ft
Wing loading	24.12lb per sq ft
Landing speed	69mph
Max speed at altitude	311mph at 10,000ft
Cruising speed	262mph
Service ceiling	33,700ft
Initial climb	2,350ft per minute
Range	820m
Armament	four .30-caliber machine guns
Gun sight	ring and post
Landing gear	retractable
Production	24, February–March 1940
Constructor's numbers	CW 13643 through 13654; 13659 through 13670

Model	H75A-7
Built for	Dutch East Indies
Manufacturer	Curtiss-Wright Aeronautical Corporation
Other names	Hawk
Aircraft operational role	fighter
Pilot/crew requirement	one pilot
Powerplant	Wright R-1820-G205A Cyclone
Rating at altitude	1,100hp at 5,100ft
RPMs	2,500
Compression ratio	6.5:1
Propeller	three-bladed
Gross weight	5,692lb
Empty weight	4,483lb
Length	28ft 7in.
Airfoil	NACA 2215 at root tapering to NACA 2209 near tips
Wingspan	37ft 3.5in.
Wing area	236sq ft
Wing loading	24.12lb per sq ft
Landing speed	69mph
Max speed at altitude	311mph at 10,000ft
Cruising speed	262mph
Service ceiling	33,700ft
Initial climb	2,350ft per minute
Range	820m
Armament	six .30-caliber machine guns
Gun sight	ring and post
Landing gear	retractable
Production	20, May 1940
Constructor's numbers	CW 14424 through 14443

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Model	H75-M
Built for	China
Manufacturer	Curtiss-Wright Aeronautical Corporation
Other names	Hawk
Aircraft operational role	fighter
Pilot/crew requirement	one pilot
Powerplant	Wright R-1820-G205A Cyclone
Rating at altitude	1,100hp at 5,100ft
RPMs	2,500
Compression ratio	6.5:1
Propeller	three-bladed
Gross weight	5,305lb
Empty weight	3,975lb
Length	28ft 7in.
Airfoil	NACA 2215 at root tapering to NACA 2209 near tips
Wingspan	37ft 3.5in.
Wing area	236sq ft
Wing loading	22.48lb per sq ft
Landing speed	64mph
Max speed at altitude	280mph at 10,000ft
Cruising speed	240mph
Service ceiling	31,800ft
Initial climb	2,340ft per minute
Range	547m
Armament	four .30-caliber machine guns
Gun sight	ring and post
Landing gear	fixed
Production	30, May–August 1938
Constructor's numbers	CW 12625 through 12754

Model	H75-N
Built for	Thailand
Manufacturer	Curtiss-Wright Aeronautical Corporation
Other names	Hawk
Aircraft operational role	fighter
Pilot/crew requirement	one pilot
Powerplant	Wright R-1820-G205A Cyclone
Rating at altitude	1,100hp at 5,100ft
RPMs	2,500
Compression ratio	6.5:1
Propeller	three-bladed
Gross weight	5,305lb
Empty weight	3,975lb
Length	28ft 7in.
Airfoil	NACA 2215 at root tapering to NACA 2209 near tips
Wingspan	37ft 3.5in.
Wing area	236sq ft
Wing loading	22.48lb per sq ft
Landing speed	64mph
Max speed at altitude	280mph at 10,000ft
Cruising speed	240mph
Service ceiling	31,800ft
Initial climb	2,340ft per minute
Range	547m
Armament	two .30-caliber machine guns and two 23-mm cannon under wings

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Gun sight	ring and post
Landing gear	fixed
Production	12, November–December 1938
Constructor's numbers	CW 12756 through 12767

Model	H75-O
Built for	Argentina
Manufacturer	Curtiss-Wright Aeronautical Corporation
Other names	Hawk
Aircraft operational role	fighter
Pilot/crew requirement	one pilot
Powerplant	Wright R-1820-G205A Cyclone
Rating at altitude	1,100hp at 5,100ft
RPMs	2,500
Compression ratio	6.5:1
Propeller	three-bladed
Gross weight	5,305lb
Empty weight	3,975lb
Length	28ft 7in.
Airfoil	NACA 2215 at root tapering to NACA 2209 near tips
Wingspan	37ft 3.5in.
Wing area	236sq ft
Wing loading	22.48lb per sq ft
Landing speed	64mph
Max speed at altitude	280mph at 10,000ft
Cruising speed	240mph
Service ceiling	31,800ft
Initial climb	2,340ft per minute
Range	547m
Armament	six .30-caliber machine guns
Gun sight	ring and post
Landing gear	fixed
Production	29, November–December 1938; 20 under license, 1940
Constructor's numbers	CW 12769 through 12797

Dozens of P-40Bs await delivery to the USAAC at Buffalo, New York, in 1941. The P-40B, equipped with armor plate, self-sealing fuel tanks, and increased armament, was the first combat-capable P-40 model.

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Army Hawk 81s

Model	XP-40
Manufacturer	Curtiss-Wright Aeronautical Corporation
Other names	Hawk 75P; later Hawk 81
Aircraft operational role	fighter
Pilot/crew requirement	one pilot
Powerplant	Allison V-1710-19
Rating at altitude	1,090hp at 10,000ft
RPMs	2,950
Compression ratio	6.65:1
Propeller	three-bladed
Gross weight	6,280lb
Empty weight	5,194lb
Length	31ft 9in.
Airfoil	NACA 2215 at root tapering to NACA 2209 near tips
Wingspan	37ft 4in.
Wing area	236sq ft
Wing loading	26.61lb per sq ft
Landing speed	72mph
Max speed at altitude	327mph at 10,000ft
Cruising speed	299mph
Service ceiling	31,000ft
Initial climb	3,750ft per minute
Range	650m
Armament	one .50-caliber machine gun and one .30-caliber machine gun
Gun sight	N2-A
Landing gear	retractable
Production	1, October 1938
Constructor's numbers	38-10

Model	P-40-CU
Manufacturer	Curtiss-Wright Aeronautical Corporation
Other names	Hawk 81-A1
Aircraft operational role	fighter
Pilot/crew requirement	one pilot
Powerplant	Allison V-1710-33
Rating at altitude	1,040hp at 15,000ft
RPMs	2,950
Compression ratio	6.65:1
Propeller	three-bladed
Gross weight	6,787lb
Empty weight	5,376lb
Length	31ft 9in.
Airfoil	NACA 2215 at root tapering to NACA 2209 near tips
Wingspan	37ft 4in.
Wing area	236sq ft
Wing loading	28.76lb per sq ft
Landing speed	80mph
Max speed at altitude	357mph at 15,000ft
Cruising speed	277mph
Service ceiling	32,750ft
Initial climb	3,080ft per minute
Range	650m

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Internal fuel	181 gallons
Armament	two .50-caliber machine guns*
Gun sight	N2-A
Landing gear	retractable
Production	199, June–October 1940
Constructor's numbers	39-156 through 220; 39-222 through 289; 40-292 through 357
* 44 aircraft converted to P-40G by fitting with H81-A2 wings carrying four .30-caliber machine guns	

Model	P-40B-CU
Manufacturer	Curtiss-Wright Aeronautical Corporation
Other names	Hawk 81-A2
Aircraft operational role	fighter
Pilot/crew requirement	one pilot
Powerplant	Allison V-1710-33
Rating at altitude	1,040hp at 15,000ft
RPMs	2,950
Compression ratio	6.65:1
Propeller	three-bladed
Gross weight	7,325lb
Empty weight	5,590lb
Length	31ft 9in.
Airfoil	NACA 2215 at root tapering to NACA 2209 near tips
Wingspan	37ft 4in.
Wing area	236sq ft
Wing loading	31.04lb per sq ft
Landing speed	80mph
Max speed at altitude	352mph at 15,000ft
Cruising speed	280mph
Service ceiling	32,400ft
Initial climb	3,000ft per minute
Range	730m
Internal fuel	160 gallons
Armament	two .50-caliber machine guns and four .30-caliber machine guns
Gun sight	N2-A
Landing gear	retractable
Production	131, January–April 1941
Constructor's numbers	41-5205 through 5304; 41-13297 through 13327

The P-40C was the last of the Hawk 81 line. It was very similar to the B-model but also had plumbing for a 52-gallon drop tank to extend its range. These were photographed at the factory in Buffalo during 1941. (Craig Busby)

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Tomahawk I AH775 of the RAF flies over England in 1942. Deemed incapable of surviving in combat with Luftwaffe fighters over the channel front, Tomahawks were assigned to army cooperation units. (Craig Busby)

Model	P-40C-CU
Manufacturer	Curtiss-Wright Aeronautical Corporation
Other names	Hawk 81-A3
Aircraft operational role	fighter
Pilot/crew requirement	one pilot
Powerplant	Allison V-1710-33
Rating at altitude	1,040hp at 15,000ft
RPMs	2,950
Compression ratio	6.65:1
Propeller	three-bladed
Gross weight	7,549lb
Empty weight	5,812lb
Length	31ft 9in.
Airfoil	NACA 2215 at root tapering to NACA 2209 near tips
Wingspan	37ft 4in.
Wing area	236sq ft
Wing loading	31.99lb per sq ft
Landing speed	86mph
Max speed at altitude	345mph at 15,000ft
Cruising speed	270mph
Service ceiling	29,500ft
Initial climb	2,690ft per minute
Range	730m*
Internal fuel	134 gallons
Armament	two .50-caliber machine guns and four .30-caliber machine guns
Gun sight	N2-A
Landing gear	retractable
Production	
Constructor's numbers	
* First P-40 model that could carry a 52-gallon drop tank under the belly	

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Export Hawk 81s

Model	Tomahawk I, IA, and IB
Built for	France*
Manufacturer	Curtiss-Wright Aeronautical Corporation
Other names	Hawk 81-A1
Aircraft operational role	fighter
Pilot/crew requirement	one pilot
Powerplant	Allison V-1710-33
Rating at altitude	1,040hp at 15,000ft
RPMs	2,950
Compression ratio	6.65:1
Propeller	three-bladed
Gross weight	6,787lb
Empty weight	5,376lb
Length	31ft 9in.
Airfoil	NACA 2215 at root tapering to NACA 2209 near tips
Wingspan	37ft 4in.
Wing area	236sq ft
Wing loading	28.76lb per sq ft
Landing speed	80mph
Max speed at altitude	357mph at 15,000ft
Cruising speed	277mph
Service ceiling	32,750ft
Initial climb	3,080ft per minute
Range	650m
Internal fuel	181 gallons
Armament	two .50-caliber machine guns and two .303-caliber machine guns
Gun sight	ring and bead
Landing gear	retractable
Production	142, September–October 1940
Constructor's numbers	RAF BK852; BK853; AH741 through AH880
* Order taken over by Great Britain when France fell in 1940	

A Tomahawk II of the South African Air Force, with its wing guns removed, receives maintenance at a base in North Africa. Three SAAF squadrons flew Tomahawks on operations in the Mediterranean theater, 1941–43. (Craig Busby)

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Model	Tomahawk II and IIA
Built for	Great Britain
Manufacturer	Curtiss-Wright Aeronautical Corporation
Other names	Hawk 81-A2
Aircraft operational role	fighter
Pilot/crew requirement	one pilot
Powerplant	Allison V-1710-33
Rating at altitude	1,040hp at 15,000ft
RPMs	2,950
Compression ratio	6.65:1
Propeller	three-bladed
Gross weight	7,325lb
Empty weight	5,590lb
Length	31ft 9in.
Airfoil	NACA 2215 at root tapering to NACA 2209 near tips
Wingspan	37ft 4in.
Wing area	236sq ft
Wing loading	31.04lb per sq ft
Landing speed	80mph
Max speed at altitude	352mph at 15,000ft
Cruising speed	280mph
Service ceiling	32,400ft
Initial climb	3,000ft per minute
Range	730m
Internal fuel	181 gallons
Armament	two .50-caliber machine guns and four .303-caliber machine guns
Gun sight	ring and bead
Landing gear	retractable
Production	110, October–November 1940
Constructor's numbers	RAF AH881 through AH900
* Order taken over by Great Britain when France fell in 1940	

Model	Tomahawk IIB
Built for	Great Britain
Manufacturer	Curtiss-Wright Aeronautical Corporation
Other names	Hawk 81-A2 and A3
Aircraft operational role	fighter
Pilot/crew requirement	one pilot
Powerplant	Allison V-1710-33
Rating at altitude	1,040hp at 15,000ft
RPMs	2,950
Compression ratio	6.65:1
Propeller	three-bladed
Gross weight	7,549lb
Empty weight	5,812lb
Length	31ft 9in.
Airfoil	NACA 2215 at root tapering to NACA 2209 near tips
Wingspan	37ft 4in.
Wing area	236sq ft
Wing loading	31.99lb per sq ft
Landing speed	86mph
Max speed at altitude	345mph at 15,000ft
Cruising speed	270mph

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Service ceiling	29,500ft
Initial climb	2,690ft per minute
Range	730m
Internal fuel	134 gallons
Armament	two .50-caliber machine guns and four .303-caliber machine guns
Gun sight	ring and bead
Landing gear	retractable
Production	829, November 1940–August 1941
Constructor's numbers	RAF AH991 through AH999; AK100 through AK570; AM370 through AM519 (minus 100 allotted to China); AN218 through AN517

Model	Tomahawk IIB
Built for	Great Britain but sold to China for the American Volunteer Group*
Manufacturer	Curtiss-Wright Aeronautical Corporation
Other names	Hawk 81-A2
Aircraft operational role	fighter
Pilot/crew requirement	one pilot
Powerplant	Allison V-1710-33
Rating at altitude	1,040hp at 15,000ft
RPMs	2,950
Compression ratio	6.65:1
Propeller	three-bladed
Gross weight	7,325lb
Empty weight	5,590lb
Length	31ft 9in.
Airfoil	NACA 2215 at root tapering to NACA 2209 near tips
Wingspan	37ft 4in.
Wing area	236sq ft
Wing loading	31.04lb per sq ft
Landing speed	80mph
Max speed at altitude	352mph at 15,000ft
Cruising speed	280mph
Service ceiling	32,400ft
Initial climb	3,000ft per minute
Range	730m
Internal fuel	181 gallons
Armament	two .50-caliber machine guns and four .303-caliber machine guns
Gun sight	ring and bead
Landing gear	retractable
Production	100, May–October 1941
Constructor's numbers	CAF P-8101 through P-8199
* These aircraft were originally part of the British order for Tomahawk IIBs	

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The Fighters of 1941

Type	Weight	Top Speed	Service Ceiling	Range
P-40C	7,549lb	345mph	29,500ft	730m
Bf 109E	5,523lb	354mph	36,000ft	412m
MC.202	6,636lb	370mph	37,730ft	475m
A6M2	5,313lb	316mph	33,790ft	1,165m
Ki-43-1a	5,695lb	308mph	38,500ft	745m
Hurricane IIA	7,300lb	342mph	36,300ft	480m
Spitfire II	6,527lb	357mph	37,200ft	500m
LaGG-3	6,316lb	352mph	33,464ft	400m
MiG-3	7,390lb	397mph	39,369ft	776m
Yak-1	6,217lb	363mph	32,808ft	528m

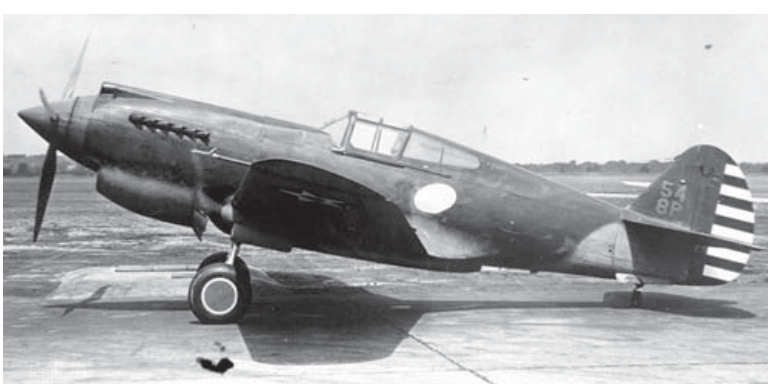
OPERATIONAL HISTORY

Curtiss delivered its first P-40-CUs to the US Army Air Corps in May 1940. These initial models mounted just two .50-caliber machine guns in the nose, though provisions were made for adding a single .30-caliber weapon in each wing. Their light armament load and lack of armor and self-sealing tanks made these some of the lightest and therefore best-flying P-40s ever built.

The first three production P-40s, starting with 39-156, were used for service trials. The 8th Pursuit Group (PG), based at Langley Field, VA, was the first operational unit to receive P-40s. The 20th PG at March Field, California, and the 31st PG at Selfridge Field, Michigan, followed by September 1940, some 200 aircraft having been manufactured.

At that point Curtiss shifted production to the French order for 140 Hawk 81As. By this time, however, France had collapsed and surrendered to Germany, so the Royal Air Force took over the contract. So urgent was the need for fighters in the United Kingdom at this time – with the Battle of Britain raging in the skies above southern England – that many of these aircraft were delivered with French instruments and cockpit lettering. Dubbed Tomahawk Is by the RAF, these aircraft were lacking in firepower and combat equipment just as the first P-40s were, so the RAF relegated them to a training role. As Curtiss was able to ramp up its production capabilities, improved models of the P-40 bound for the USAAC and the RAF were built concurrently. Eventually, 21 RAF and Commonwealth squadrons flew Tomahawks, 2 Squadron in the UK being the first.

Curtiss delivered 199 P-40-CUs between June and October 1940, the first service models going to the 8th Pursuit Group at Selfridge Field, Michigan. The 20th PG at March Field, California, and the 31st PG at Selfridge were next to get P-40s. (Craig Busby)



Meanwhile, tensions were rising in the Far East, the United States closely watching Japan's ongoing war with China and its aggressive posturing elsewhere in the region. When Curtiss began delivering P-40Bs to the USAAC in January 1941, 55 of them were assigned to the 15th and 18th PGs at Wheeler Field, Hawaii, and 31 went to the 24th PG at Clark Field in the Philippine Islands. P-40C deliveries started in April, and a complement of these was flown

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to the Caribbean to equip the 16th PG in Panama, which was tasked with providing air defense for the Panama Canal. The 35th Pursuit Squadron (PS) of the 36th PG, in Puerto Rico, also got P-40Cs.

Farther north, the 33rd PS of the 8th PG made the first of many P-40 deployments by aircraft carrier when its pilots flew 30 new P-40Cs off the deck of the USS *Wasp* on August 6, 1941, and landed 97 miles away in Reykjavik, Iceland. The mission of the Americans was to enforce the "neutrality" of Iceland by denying its use to Axis forces while making sure its facilities remained available for use by the Allies. The 33rd would remain in Iceland throughout the European war and share in the destruction of two Luftwaffe aircraft, though neither combat involved its P-40Cs. The original P-40Cs did, however, remain in service for a long time, with the last six being retired in June 1944 when the squadron re-equipped with P-47s.

Lt Roland Wilcox taxis out at an airfield in Florida for a flight to deliver a new P-40C to the 36th PG in Puerto Rico during the spring of 1941. The 52-gallon drop tank provided a level of security during the overwater portions of the trip.

At War in the Middle East

The first Hawk 81s to arrive in a war zone were the Tomahawk Is delivered to the Royal Air Force in 1940. Tomahawk IIs, the first combat-capable Hawk 81s delivered to the Royal Air Force, began to arrive in England in early 1941. Recognizing that the new fighter was at its best at medium and low altitudes, the RAF assigned Tomahawks to squadrons primarily engaged in army cooperation duties. These aircraft were to be employed against the German invasion expected in summer 1941.

One of the new Tomahawk units was No. 403 Squadron RCAF (Royal Canadian Air Force) formed at Baginton on Tomahawk IIs in March 1941. The squadron became operational on May 11, 1941, and went on to fly 29 operational sorties, mostly scrambles, by the end of the month but without incident. The squadron re-equipped with Spitfires on June 11, 1941. In all, 16 Tomahawk squadrons based in England worked up on the type. Apparently, one Tomahawk from No. 410 Squadron RCAF made an unauthorized strafing sortie over occupied Europe on August 28, the only Britain-based Tomahawk known to have seen action.

A trio of Tomahawk Is assigned to 403 Sqn RCAF flies in cloudy weather over England during the spring of 1941. The Tomahawk I was similar to the P-40-CU but carried four .303-caliber wing guns. (Craig Busby)

The Soviet Union received 146 Tomahawks, drawn from RAF stores in England and from the USAAF (previously the US Army Air Corps), after the Germans invaded Russia in June 1941. They were the first US-built aircraft to fight on the Eastern Front, going into action on the Leningrad front and in defense of Moscow in October 1941. By that time, Tomahawks had already been fighting in the Middle East for several months.

About 300 Tomahawk IIBs were shipped to Takoradi, West Africa, in the spring of 1941 for delivery to the Desert Air Force (DAF). These aircraft were to serve in six squadrons: 112 and 250 RAF; 2, 4 and 5 SAAF (South African Air Force); and 3 RAAF (Royal Australian Air Force). First to acquire Tomahawks was 250 Sqn,

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One of the first units to fly the Tomahawk in combat in the Middle East was 3 Sqn RAAF. This Tomahawk IIB, AN355, flew in Operation *Exporter*, the 1941 Allied invasion of Syria and Lebanon. (Craig Busby)

which began forming at Aqir, Palestine, in April under Sqn Ldr John Scoular.

Ten Tomahawks of 250 Sqn moved to Amriya, Egypt, on May 12, 1941, to stiffen air defense for the port city of Alexandria, and the rest of the squadron followed 10 days later. On June 8, Flg Off Jack Hamlyn and Sgt Paxton were on a patrol when they spotted an Italian Cant Z.1007 and attacked it. Hamlyn's fire damaged the plane, which was on its way to a water landing when ground fire from shore batteries finished it off. Hamlyn nevertheless was credited with destroying the Cant, giving him the first aerial victory ever scored in a Tomahawk P-40.

Operation *Battleaxe*, a new British offensive in Egypt, began on June 14, 1941, with 250 Sqn helping to provide an "umbrella" of air cover over the ground forces. The objective was to clear Axis forces from eastern Cyrenaica and break the siege of Tobruk, but stiff German opposition turned the British away. Four days later, as the unsuccessful British ground forces retreated, Flg Off Hamlyn became the first Tomahawk pilot to be shot down when he was hit by flak while strafing. Hamlyn was able to make a forced landing in the desert and rejoined his unit several weeks later. The Luftwaffe did not make an appearance over the battlefield until the second week of the operation, but regular combats took place after that. Plt Off Clive R. "Killer" Caldwell, destined to become the top-scoring P-40 pilot of all time, scored his fifth victory to become the first Tomahawk ace on July 7.

Meanwhile, Operation *Exporter*, the Allied invasion of Vichy French-controlled Syria and Lebanon, had also gotten under way. Seeking to deny Germany a route into the Middle East from Greece, Allied ground forces attacked westward from Iraq, while air cover was provided from bases in northern Palestine. No. 3 Sqn RAAF, which re-equipped with Tomahawks in May after having flown Hurricanes in the Western Desert and Gladiators before that, took part from the first day of the campaign, June 8, to its end on July 14.

On the opening day of the operation, five Tomahawks led by Sqn Ldr Peter Jeffrey in Tomahawk AK476 strafed the Armée de l'Air airfield at Rayack, destroying one D 520 fighter and damaging several others. The squadron recorded its first Tomahawk aerial victories on June 13 when Sqn Ldr Jeffrey

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EARLY RAAF TOMAHAWK COMBAT, JUNE 28, 1941

What is likely the first air combat of World War II pitting American-built aircraft on both sides took place during Operation *Exporter*, the Allied invasion of Vichy French-controlled Syria and Lebanon in June and July 1941. No. 3 Sqn RAAF, recently re-equipped with some of the first Curtiss Tomahawk IIBs to reach the Middle East, took part from the first day of the campaign, June 8, to its end. On June 28, nine 3 Sqn Tomahawks led by Flight Lieutenant Alan Rawlinson flew from Palestine up to Damascus-Mezze and refueled, taking off again at 10:15 to escort Blenheims on a bombing raid. Meanwhile, at 10:10 six Martin M-167F twin-engine bombers of Aeronavale Flotille 4F had taken off to bomb Allied troops in the vicinity of Palmyra. The Blenheims completed their attack, and then the Australians spotted the explosions of bombs dropped by the Aeronavale aircraft, all six seen bombing in pairs. Rawlinson immediately attacked, and within a few moments all the Martins were shot down, four of them crashing with total loss of life. The Tomahawks returned to Damascus without damage, three victories being credited to Rawlinson, two to Flying Officer Peter Turnbull, and one to Sergeant Rex Wilson.

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led eight Tomahawks providing escort for a Royal Navy cruiser off the coast near Saida. Luftwaffe Ju 88s of 2nd Staffel Lehrgeschwader 1 (flying from Eleusis) attacked the ship, but 3 Sqn claimed three bombers destroyed (including one by Jeffrey) and two damaged. The last combat occurred on July 11, when 3 Sqn was bounced near Aleppo by Lt Lete in a D 520 of Groupe de Chasse II/3. One Tomahawk was shot down before Flg Offs John Jackson and Bobby Gibbes downed the D 520. Later that day, the Vichy commander, General Dentz, accepted the armistice terms dictated by the Allies. During the five-week campaign, 3 Sqn destroyed or damaged 31 enemy aircraft.

In North Africa, British forces continued to hold the surrounded port city of Tobruk throughout the summer of 1941. The Australians of 3 Sqn RAAF returned to Egypt in late August. By that time, a second Tomahawk squadron, 2 Sqn SAAF, had gone into action alongside 250 Sqn. They would be joined soon by 112 Sqn, a former Gladiator outfit that had been working up on Tomahawks in Palestine since June. When 112 Sqn joined the fight, its Tomahawks sported a fearsome shark's-mouth design painted on their noses. Before long, the squadron's combat success and colorful markings would combine to make 112 Sqn the most famous unit in the DAF. The month also saw the arrival of Tomahawks in a new desert camouflage scheme of dark earth and middle stone over azure blue. The top surfaces followed the existing pattern, with dark earth remaining as before and middle stone simply replacing the dark green of the previous color scheme.

A singular Tomahawk mission, one that illustrates the Curtiss fighter's legendary ability to absorb combat damage, occurred on August 29 when Clive Caldwell of 250 Sqn joined combat with I/JG (Jagdgeschwader) 27 pilot Werner Schroer, flying a Bf 109E. Schroer got the best of the scrap, wounding Caldwell and setting his Tomahawk on fire in the process before breaking off to return to base and claim a Tomahawk destroyed. Caldwell wasn't finished for the day, however. The fire suddenly burned itself out just as Caldwell was about to bail out, so he regained his seat and resumed flying the plane. He soon spotted a formation of enemy aircraft and attacked, overcoming his wounds to shoot down a Bf 109 before returning safely to his base.

On that same day, Allied fighter squadrons began moving up to landing grounds in the Sidi Barrani area of western Egypt. This aggressive action placed them closer to Tobruk but left them exposed to Axis air attack, setting up a new round of air combats. Seven Tomahawks of 2 Sqn SAAF scrambled

This Tomahawk IIB of 112 Sqn RAF was one of the first to carry the unit's famous shark-face motif on its nose. The dark earth/dark green topside camouflage dates this photo as prior to late August 1941. (Craig Busby)

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at Landing Ground 03 on September 3 when a formation of Italian aircraft was reported to be approaching. The South Africans caught 27 Fiat G 50s on the deck at 150 feet altitude and downed six of them for no loss, though one Tomahawk was shot down by friendly ground fire. The Italians got a measure of payback four days later when they caught 2 Sqn SAAF on the ground and destroyed two Tomahawks by strafing. Plt Off Neville Bowker claimed the first of 38 Tomahawk victories for 112 Sqn when he destroyed an Italian SM 79 bomber near Sofafi on September 14.

The situation for Tomahawk pilots in the desert took a turn for the worse in early October when the Luftwaffe's II/JG 27 joined the fight, equipped with Bf 109Fs. While the Tomahawk, when flown effectively, was able to hold its own against the Bf 109E, the new model changed the game. With more speed and better maneuverability than the earlier version, the Bf 109F gave its pilots a clear advantage over their opposition. It also did not help that DAF squadrons continued to tinker with prewar combat formations that were inferior to the Luftwaffe's four-plane system, which the Allies later would adopt as the "finger-four."

Nevertheless, the first encounter between Tomahawk and Bf 109F ended in the Tomahawk's favor on October 3 when Lt Lacey of 2 Sqn SAAF scored a victory as his flight of three was jumped by II/JG 27 while in the landing pattern at Sidi Barrani. The balance tipped back in favor of the new German fighter later that day, however, when Oblt Rodel and Lt Schacht of II/JG 27 claimed victories in a scrap with 112 Sqn, and the Bf 109F would maintain its dominance over the Tomahawk (and DAF Hurricanes as well) from then on.

A fifth Tomahawk squadron, 4 Sqn SAAF, moved up to Landing Ground 110 near Sidi Barrani in mid-October as the British again built up air strength in anticipation of a new ground offensive to break the siege at Tobruk. The squadrons were organized under new fighter wings, with 258 Wing getting 2 Sqn SAAF and 3 Sqn RAAF plus four Hurricane units, and 262 Wing with 4 Sqn SAAF, 112 Sqn RAF, and 250 Sqn RAF plus three squadrons with Hurricanes. On the Axis side, new Macchi C 202s gave the Italian pilots of 9 Gruppo and 1 Stormo a fighter that was as good – and in some ways better – than the Bf 109F.

Operation *Crusader* shoved off on a rainy November 18, and Axis aircraft remained grounded for two days by muddy conditions on the airfields around Gazala. The surprise attack was successful, the Eighth Army advancing west from its base at Mersa Matruh and crossing the Libyan border some 50 miles south of Sidi Omar, and then pushing to the northwest.

The Tomahawk squadrons were heavily involved throughout the back-and-forth campaign, which eventually resulted in the Axis forces under Gen Erwin Rommel withdrawing nearly 500 miles to El Agheila, Libya. Fighter-bomber tactics played an important role, as Tomahawks and Hurricanes ranged ahead of the ground forces to attack Rommel's lines of communication. Typical Tomahawk missions would pair two squadrons, one providing top cover while the other sought out enemy columns, truck convoys, and supply dumps on the ground to strafe. Other mission profiles included fighter sweeps and bomber escorts, with large air battles occurring on a regular basis. Losses were heavy: no fewer than nine Tomahawks of 3 Sqn RAAF went down on November 22, for instance, with five pilots killed.

Operation *Crusader* was starting its second week on 25 November when 12 Tomahawks of 112 Sqn plus five more from 3 Sqn RAAF took off on a mid-afternoon sweep of the Sidi Rezegh area. They encountered a mass of

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KJ-M, a well-worn Tomahawk II of 4 Sqn SAAF, force-landed in the Egyptian desert in mid-1942. Leading Tomahawk aces in 4 Sqn were Andrew C. Bosman and Douglas W. Golding. (Craig Busby)

about 70 enemy aircraft, including Me 110 twin-engine fighters, Ju 87 and Ju 88 bombers, and even some Italian CR 42 biplanes, all escorted by Bf 109s on top cover. The Tomahawks attacked with success: 112 Sqn claimed two destroyed and two probables for the loss of Sgt Glascow, while 3 Sqn RAAF's claims were seven destroyed, one probable, and eight damaged, though Flg Off Evan failed to return. Sgt Rex Wilson of 3 Sqn RAAF was credited with three destroyed and three damaged for the top score of the mission. Peter Jeffrey, now a wing commander, scored his fifth victory during the scrap.

Ace Clive Caldwell was leading a mission with 22 Tomahawks of 250 Sqn and 112 Sqn on December 5 when another huge air battle occurred, this time in the skies near El Adem. The Tomahawks engaged a formation consisting of 40 Ju 87 Stukas escorted by a similar number of Bf 109s and Italian fighters. Caldwell led 250 Sqn into the Stukas from above and behind, while 112 Sqn took on the escorts. Caldwell claimed no fewer than five Stukas of the 14 victories credited to the Tomahawk pilots, and the Bf 109s shot down five Tomahawks.

Combats continued throughout the month, but time was catching up with the Tomahawks of the DAF. Their numbers dwindled with each combat loss, and the survivors were piling up flying hours at a rapid pace. What is more, Curtiss had delivered its last Tomahawk to the RAF in August, when its factories shifted production to a new Hawk fighter, the H-87 Kittyhawk. So there were no more Tomahawks to be had. The first squadron to re-equip with Kittyhawks was 3 Sqn RAAF, which dispersed its eight remaining Tomahawks to 112 Sqn, 2 Sqn SAAF, and 4 Sqn SAAF on December 17. The Sharks of 112 Sqn soon followed suit, receiving their first Kittyhawks on December 29. During four months of operations on Tomahawks, 112 Sqn had used 68 aircraft and lost 20 to enemy action. Only two Tomahawks, AK475 (GA-J) and AK 451, remained in service with the squadron throughout the entire period.

Tomahawk strength took another hit on January 7, 1942, when 2 Sqn SAAF and 4 Sqn SAAF lost seven aircraft – six shot down by BF 109s and one due to engine failure. Operation *Crusader* ended a week later, but its success was short-lived. On January 21, Rommel launched a surprise counterattack from El Agheila. Finding the Eighth Army forward elements to be thinly spread and tired, he took advantage of the situation and drove the British back to Gazala, where they took up defensive positions along Rommel's old line. A stalemate lasting several months ensued as both sides regrouped.

When 250 Sqn withdrew to El Gamil to re-equip with Kittyhawks on February 3, just the two South African Tomahawk squadrons remained on

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strength in the DAF. They were joined a month later by a new Tomahawk squadron, 5 Sqn SAAF, commanded by noted ace Major John E. "Jack" Frost. This squadron would continue to fly Tomahawks long after the others converted to Kittyhawks, taking a major part in the fighting during the retreat from Libya into Egypt in the summer of 1942. The squadron suffered heavy losses during that period, including Major Frost, who was killed in a fight with Bf 109Fs on June 16, 1942, and three other commanding officers. The squadron continued flying Tomahawks through the battle of El Alamein, not receiving Kittyhawks until January 1943.

Action in the Pacific

The war among European powers exploded into a true world war when two waves of carrier-based Japanese aircraft attacked American installations at Pearl Harbor, Hawaii, on Sunday morning, December 7, 1941. The surprise attack was highly successful, crippling US naval power in the Pacific and leaving the air defenses of Hawaii in a shambles. Less than a day later, American air forces in the Philippine Islands were similarly shattered by Japanese air attacks, leaving that US territory virtually defenseless against further bombing raids.

The Curtiss P-40, as the front-line US Army fighter of that time, attracted heavy criticism in the months that followed, under the assumption that it had proved inferior to Japanese aircraft – especially the A6M "Zero" naval fighter – in aerial combat. While it is true that the P-40 lacked a speedy rate of climb that would have made it a better interceptor, the fact remains that the plane played an insignificant role in the first days of the Pacific air war. Due to a fatal combination of Japanese aggressiveness, failures of American leadership, and a hefty dose of bad luck, only a handful of P-40s survived to get off the ground on December 7–8. Most lay damaged or destroyed on their own airfields after having been caught defenseless by the initial Japanese air raids.

Historians have struggled to explain how the United States forces could have been surprised at Pearl Harbor by the Japanese. American military leaders and President Roosevelt were not unaware of Japan's hostile intentions, because US naval intelligence had broken Japan's diplomatic radio code some months earlier. Nor were the Americans lacking sufficient military assets to defend Pearl Harbor from aerial attack. Of 231 military aircraft stationed on the island of Oahu, 115 were Army P-40 and P-36 fighters of the 14th Pursuit Wing providing air defense. Nine pursuit squadrons in Hawaii were fully or partially equipped with P-40s. Army B-17 and B-18 bombers were available for patrol duties, as were Navy PBY flying boats, and a new net of radar stations provided further aerial surveillance.

For all the military hardware defending Pearl Harbor, the American forces were, as one newspaper later termed it, "caught with their pants down" by the Japanese on December 7, 1941. The American Army and Navy commanders in Hawaii had received a "war warning" from Washington, DC, on November 27. But lacking respect for Japan's military capabilities and an appreciation of the destructive power of a modern attack from the air, they decided that the

One of the few American fighter pilots to get airborne during the Pearl Harbor attack on December 7, 1941, was Lt Emmett S. "Cyclone" Davis of the 45th PS, right, who poses here with his crew chief and their P-40B shortly after the action. Davis went on to score three victories in the South Pacific during 1943.

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greatest threat to Pearl Harbor was from local sabotage. Accordingly, they had ordered fighters and bombers moved out of the protective dispersal areas around their airfields to be bunched up on the hangar lines, where they would be easier to guard. They ordered no increase in aerial reconnaissance missions, and they placed the battleships moored at the Ford Island piers on Condition 3, which called for partial manning of antiaircraft batteries while roughly a third of the ships' crews were allowed shore leave. The radar stations were on minimum manning by inexperienced or completely untrained personnel. And on Saturday, December 6, all non-essential Army personnel at Wheeler Field had been given the weekend off. There was a big dance at the officers' club that night.

Army pursuit pilots considered Hawaii a plum assignment prior to the outbreak of the war. Their workdays were short, their accommodations at Wheeler Field were comfortable, and there was plenty of fun to be had during off-duty hours. Among those pilots was 2nd Lt Emmett S. Davis of the 45th PS. On February 26, 1940, Davis was one of 30 pilots who made Army history when they flew their P-36s off the deck of the USS *Enterprise* for delivery to Wheeler Field, the first such launch of Army fighters from a carrier. In the months that followed, Davis earned such notoriety for his abilities in the cockpit of a P-40 that he picked up the nickname "Cyclone."

At 5:55am on December 7, Lt Cmdr Mitsuo Fuchida's strike force began launching from six Japanese carriers about 200 miles due north of Honolulu. An Army radar station on the north coast of Oahu spotted the incoming formation just over an hour later, but the pursuit officer on duty mistook the plot for a flight of B-17s due to arrive from California that morning and told the station to ignore it. Much has been made over the years of the failure to sound the alarm, but in fact 40 minutes' warning would have made little difference to the 14th Pursuit Wing's ability to defend Pearl Harbor. On that morning, the bulk of the fighter force was a toothless dragon, the guns of many P-40s and P-36s at Wheeler Field having been removed for safe keeping in a locked area of the main hanger. The time required to reinstall and load the guns, combined with the slow climb rate of the planes, would have rendered the warning moot.

At 7:55am Fuchida gave the order to attack. Lt Akira Sakamoto's Vals immediately bombed the installations and flight line of Wheeler Field, then began strafing the field. They circled in a counterclockwise direction for 20 minutes, shooting up anything that looked like a worthwhile target. Lt Kiyoguma Okajima, leading a flight of A6M2 Zero fighters assigned to escort the Vals, decided he could add nothing to the carnage below him and left the area to strafe another target, the naval air station at Barber's Point. Later, a flight of Zeros from the second wave of the attack strafed the field again. Fortunately, thick black smoke rising from the burning American planes shielded the aircraft of two squadrons at the west end of the flight line from view, and most of them survived the attack.

When the first attack began, Cyclone Davis was sleeping off a late-night poker game in the officers' quarters at Wheeler. Awakened by shouts of alarm, he quickly dressed and then hitched a ride with another pilot to the hanger area. Davis recalled:

> The Wheeler Field flight ramp was oriented from east to west on the south side of the aircraft hangars. The wind was from the east at about 10 knots. The east end of the ramp was loaded with P-40B type aircraft awaiting shipment to Midway

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Island. They were parked wingtip-to-wingtip and nose-to-tail. The attacking Japanese had set these aircraft on fire, and the smoke from the burning planes covered the aircraft to the east. This provided a protective covering for these planes, and the strafing (Japanese) pilots could not see them to set them on fire.

P-40Bs delivered to the Philippine Islands in May 1941 were concentrated in the 20th PS/24th PG. Lt Charley Sneed, a section leader in the squadron, poses here on the wing root of No. 53. (William H. Bartsch)

I ran to the flight line and proceeded to start and taxi three fighters nearest the other burning aircraft to a safer area to the west. The fourth aircraft I got in was a P-40B. The enemy attack appeared to be over, so I decided to taxi it out to the bunker that we used when we were on alert. The guns in my squadron's planes had been taken out and stored in the armament shop. So after parking the aircraft in the nearest bunker, I ran to the club and got into my car and drove to the hangar. I found an armament crew chief, and he and I proceeded to break the lock on the armament shop door. We took out six machine guns, two .50-caliber and four .30-caliber guns. We loaded them into the back of my Oldsmobile sedan and drove back to the bunker with the P-40B in it. We put the machine guns in the plane; the two .50 caliber guns went into the nose, synchronized to shoot through the propeller. Two .30-caliber guns were installed in each wing. Just before we finished, a Japanese Val divebomber attempted to strafe us in the bunker, but I think he was out of ammunition. He was very low, less than 50 feet, I would estimate. The tail gunner was facing backwards in the rear cockpit, with a devilish grin on his face.

The armament crew chief and I finished loading the ammunition. I cranked up the engine and made a takeoff to the west from that bunker location. After my gear was up, as I headed towards the mountains to the west, I fired the guns briefly. A miracle happened: All of my guns fired. I called Fighter Control, located at Fort Schafter, and told them I was airborne with one P-40. Did they have any instructions for me? They asked me to fly to Barber's Point, which is located on the coast west of Pearl Harbor, and investigate an enemy landing that had been reported. I flew to Barber's Point and found no sign of a landing. I reported this back to the control center. At this location the Army did have an antiaircraft battery. I also saw an O-47 observation aircraft flying there. As I flew back, I got another good look at Pearl Harbor with several ships burning on Battleship Row. There was also much smoke from the Marine base at Ewa.

Three more P-40s had taken off from Wheeler Field. I intercepted them just south of the field. The pilots were lieutenants Gabreski, Shifflet and Laurance, all from my squadron. I told Fighter Control that I now had four P-40s. They instructed me to go to Hickam Field to escort some B-18 bombers out to look for the Japanese fleet. As we approached the northeast corner of Pearl Harbor, the Navy guns that were functional started shooting at us. I turned the flight back toward Wheeler, told Fighter Control that they would have to get the Navy under control before any escort would be available. After we landed and were refueled, I led two more patrol flights that day. They were both uneventful.

Though Lt Davis and the others from the 45th PS got airborne too late to catch the withdrawing Japanese attackers, 14 Army fighter pilots did manage to engage the enemy on December 7, flying a total of 18 sorties. Two pilots of

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the 44th PS and three of the 47th PS flew a total of nine P-40 sorties during the Japanese raids. P-36 pilots flew the remainder of the sorties. It is significant that the 44th and 47th squadrons performed all the P-40 encounters, because neither unit was based at Wheeler at the time of the attack. Thus both were spared the first wave of Japanese attacks. The 44th had 12 P-40s at Bellows Field, but only three of its pilots were on the base that morning. A single strafing pass by Zeros at about 9am killed one pilot in the cockpit of his plane on the ground and caught two P-40s just taking off. Both were quickly shot down, with one pilot killed and the other wounded.

The 47th PS was more fortunate. Its mixed complement of 18 P-40s and P-36s was at Haleiwa, an auxiliary field on the coast about 10 miles west of Wheeler, where the squadron had been undergoing gunnery training. Japanese intelligence was unaware of the airfield, and therefore it was not targeted. Most officers of the 47th PS had deserted their tents at Haleiwa on Saturday in favor of more comfortable accommodations at Wheeler. When the bombs began to fall on Wheeler Sunday morning, 2nd Lts George S. Welch and Kenneth M. Taylor of the 47th PS called Haleiwa to alert the men there to the attack and to order their P-40Bs prepared for flight. Then they leaped into Taylor's car and sped across the island toward the base, dodging a couple of strafing attacks on the way. Several other 47th pilots followed a few minutes later.

When Welch and Taylor reached Haleiwa their planes were ready, and they took off shortly after 8:30am Unfortunately, their twin .50-caliber cowl guns were not loaded because no ammunition for them was stored at Haleiwa. As they headed east toward Pearl, the two pilots knew they would have to make do with just the four .30-caliber wing guns in their planes. Reaching the Marine base at Ewa, the pair spotted about 20 D3A1 Vals strafing the facility. Welch, the high-spirited son of an influential DuPont research scientist, gave this account of his first encounter with enemy aircraft:

> I was leading and peeled off first. Lieutenant Taylor was about 200 yards to the rear and side, following me. Their rear gunners were apparently shooting at the ground because they didn't see us coming. The first one I shot down, the rear gunner didn't even turn around to face me. I got up close enough to see what he was doing. I got him in a five-second burst – he burned right away.
>
> I left and got the next plane in the circle, which was about 100 yards ahead of me. His rear gunner was shooting at me. One bullet put a hole through my cooling radiator, and I got one in the nose. It took three bursts of five seconds each to get him. He crashed on the beach.

Ken Taylor's account of the flight reveals his inexperience at air combat:

> The first aircraft I shot at burst into flames immediately, rolled over in a ball of fire and dove into the ground near Ewa Field. I then proceeded up the string, catching the next Val, which also went down quite easily. By that time the formation was in general disarray, and I had completely lost track of George.
>
> I then tagged onto a third Val that was offshore near Barber's Point. I pulled up very close to this aircraft with the rear gunner plainly visible firing at me … Because of the close proximity, I saw that he was killed with my first burst. However, despite all the hits that I was getting, this aircraft did not burst into flames, as the others had, but started a gradual descent smoking badly. Although I turned for home, this plane also undoubtedly went down at sea. It was most frustrating at this point to find I was out of

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Nearly all of the 24th PG's P-40Bs were destroyed on the ground at Clark Field by Japanese bombers on the first day of the war. Due to a shortage of ammunition in the Philippines, none of the pilots of the 20th PS had fired the guns of their P-40s by then. (William H. Bartsch)

ammunition at a time when these much slower aircraft were making a hasty retreat to their carrier. With more ammunition, or more judicious use earlier, I could have caught and destroyed several more of them.

Welch and Taylor landed at Wheeler to rearm and refuel. At about 9:30am, a flight of Vals approached the base, intent on strafing, and Welch took off immediately with another partial load of ammunition. Taylor was a few moments behind him, just long enough for the Vals to begin their strafing runs. Taylor made his takeoff run directly at the oncoming Japanese bombers and began firing as soon as his wheels left the ground. Picking up speed, he made a tight chandelle and happened to roll out behind the next-to-last Val in the line. Taylor started firing just as the last Val started shooting at him. Taylor took some hits, including a bullet through his left arm, but fortunately Welch dropped in line behind the Val and shot it off Taylor's tail. Though wounded, Taylor chased the retreating Vals out to sea until he expended the last of his ammunition. Welch flew to Ewa, where he spotted a lone Val and shot it down just off the beach at Barber's Point.

Welch went up a third time that morning, accompanied by 2nd Lt John Dains of the 47th PS in a P-36. Earlier, Dains had made two sorties in a P-40 from Haleiwa and apparently shot down a Japanese bomber in a combat witnessed by personnel at the Kaawa radar station. The Japanese raiders had cleared the area by this time, but the airspace over Oahu was still a dangerous place to be. As Dains approached Wheeler Field to land, he was fired on by jumpy antiaircraft batteries at Schofield Barracks and crashed to his death on the golf course.

Welch was credited with four confirmed victories on December 7, Taylor got two, and Dains one. Two P-40s were lost, with one pilot killed. Viewed statistically, the P-40's combat debut in US Army service might be viewed as a success. But as a practical matter, the P-40 interceptor force had failed in its assigned task to defend Pearl Harbor from air attack. The P-40's reputation received an undeserved black mark, one that would darken in the days ahead.

The Japanese attack had shattered the battleship forces of the US Navy's Pacific Fleet. Similarly, the 14th Pursuit Wing suffered 61 P-40s and P-36s destroyed plus 41 disabled. Had the Japanese sent a third wave of attackers in the afternoon, only 38 Army fighters would have been available to intercept them. But the Japanese did not return.

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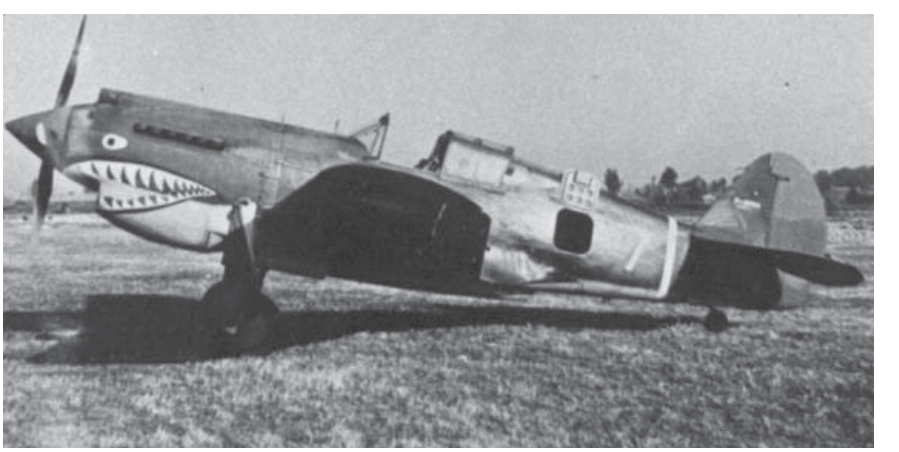
Word of the Pearl Harbor attack was flashed by radio to the headquarters of Gen Douglas MacArthur in Manila shortly after Japanese bombs stopped falling on Battleship Row in Hawaii. It was 3:55am, December 8, local time in the Philippine Islands, and within hours a Japanese triumph even greater than the destruction of the American fleet at Pearl Harbor would begin to unfold. Again, the task of providing air defense would fall primarily to Curtiss P-40s, and once more the sturdy fighter's reputation would be tarnished by failures not of its own making.

On paper, the fighter strength deployed by the Far East Air Force's 5th Interceptor Command on Luzon in early December 1941 looked substantial. Of approximately 100 P-40s in four squadrons, 75 percent were new E-models. P-40Bs were concentrated in the 20th PS, but the 34th PS had even more outdated Seversky P-35As. These squadrons were units of the 24th Pursuit Group, which was headquartered at Nichols Field just south of Manila. Two pursuit squadrons were at Nichols, and the other three were dispersed at Del Carmen, Clark, and Iba airfields, all northwest of the city. In addition, a radar station was in operation at Iba, on the west coast of Luzon.

But the 24th PG was far from ready for war. First, the obsolete P-35As at dusty Del Carmen had been in service for nearly two years and were worn out. The 23 P-40Bs of the 20th PS at Clark Field, delivered in the summer of 1941, were in good condition, but their guns had never been fired. The P-40Es were brand new and subject to several teething problems, including engine fires.

Just as importantly, many of the pilots were fresh out of flying school and unfamiliar with their P-40s. Even the most experienced pilots in the 24th PG acknowledged that they lacked training and practice in combat tactics, and their radio communications were feeble. Meanwhile, 300 miles north of Manila on the island of Formosa, Japan had amassed a force of nearly 200 A6M Zero fighters, 200 navy bombers and about 150 army aircraft. Many of the men who flew these planes were veterans of combat in China. They were well trained, they knew their aircraft, and they were eager to fight for their country.

Despite ample warning of attack, US Army air units in the Philippines were all but wiped out on December 8. A ground fog on Formosa delayed the takeoff of the Japanese strike force for several hours that morning. This allowed the P-40s and B-17s at Clark Field just enough time to take off on patrol, exhaust their fuel supplies, and return to base before the Japanese raiders arrived at about 12:20pm.



The American Volunteer Group, Chinese Air Force, received 100 Hawk 81-A2s (Tomahawk IIBs) originally bound for the RAF in Burma during the summer of 1941. No. 7 of the 1st PS was assigned to Bob Neale, who became the AVG's leading ace.

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The 20th PS, dispersed at Clark, was ready to take off but received no orders from group headquarters. Finally, squadron commander 1st Lt Joseph H. Moore ordered the scramble himself when a line chief spotted an incoming formation of Japanese aircraft. Most of the P-40Bs of the 20th PS were still preparing to taxi when they were struck by the first wave of 27 Japanese twin-engine Nell bombers. Strafing followed, and within minutes all but a few of the P-40Bs were reduced to junk. The exception was Moore's No. 41, which had been parked in a revetment and was untouched.

Within days of the attack No. 41 was the last remaining P-40B in the Philippines. It primarily flew reconnaissance missions until March 1, 1942, when Lt John Burns wrecked the plane in a landing accident at Cabcaben. Mechanics there rebuilt it with a combination of P-40B and P-40E parts to create the "P-40 Something." On April 13, Lt Gus Williams was flying the plane on a solo mission to reconnoiter and strafe the enemy-held airstrip at Davao when he encountered two Japanese floatplanes and joined combat. The canopy flew off the P-40 in a tight turn shortly before its engine quit, but Williams was able to land safely at Del Monte No. 1 airfield. Lt Larry McDaniel took off the next day in the P-40 Something to fly it through a rain storm to Del Monte No. 3. The plane stalled on final approach at its destination and crashed, killing McDaniel and spreading pieces of the P-40 Something over a wide area.

The short combat history of long-nosed P-40s in the Pacific was over.

Ken Jernstedt, a flight leader in the 3rd PS, was credited with seven ground kills during the March 18, 1942, two-plane raid on Moulmein, while Bill Reed got eight. Jernstedt, an Oregonian, went on to a career in politics after the war.

The American Volunteer Group

Though the reputation of the P-40 acquired a permanent scar during the opening days of the Pacific War, that wound was largely offset in the eyes of the American public by the combat exploits of an independent unit flying P-40s in Chinese markings on the mainland of Asia. Technically, that unit was the 1st American Volunteer Group of the Chinese Air Force, but by the spring of 1942 the western press corps had spread word of the AVG's combat exploits under a more colorful name, the Flying Tigers.

The unlikely story of the AVG began in August 1937, when the Chinese Nationalist government hired a recently retired US Army Air Corps captain, Claire L. Chennault, to help build a modern air force for the war-torn country. Japan had instigated the conflict with China earlier that year and was making steady progress in eastern China with virtually no opposition in the air. Chennault set to work, and over the next three years he improved pilot training, built airfields, and installed a crude but effective air raid warning system. But by 1940 it was clear to Chennault, a strong advocate for pursuit aviation during his USAAC career, that China could not defend itself in the sky without help from the United States.

Intense lobbying by Chennault, Chinese Nationalist leader Chiang Kai-shek, and Lauchlin Currie, an economist in the Roosevelt White House, eventually swayed US President Franklin D. Roosevelt, and in April 1941 he authorized the creation of a clandestine "Special Air Unit" for service in China. The unit would be equipped with American aircraft and staffed by

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aviators and technicians recruited from the US Army, Navy, and Marine Corps. Recruiting started immediately, candidates being told their mission was to defend the Burma Road so that supplies could continue to flow from the great port at Rangoon overland to China. Meanwhile, Great Britain agreed to transfer delivery of 100 Hawk 81-A2s ("P-40s" in AVG terminology) to the Chinese Air Force in exchange for a like number of later model fighters subsequently.

By midsummer 1941 the first personnel and P-40s began arriving at a remote RAF airbase in Toungoo, Burma, for training. Chennault lectured his pilots on the tactics he had developed during four years of observing Japanese aerial operations. He instructed his pilots to use the P-40's strengths to make diving attacks on enemy formations, then zoom back up to regain an altitude advantage, and told them never to try to engage in a turning fight with the more maneuverable Japanese fighters. Meanwhile, flight training was taking a serious toll on AVG aircraft strength, because few of the pilots had flown a P-40 before, and many had no fighter experience whatsoever. Three pilots died in training accidents, and several more resigned to return home.

A popular misconception, fueled by media reports and a popular movie starring John Wayne, held that the AVG was engaged against the Japanese prior to America's entry in to the war. In fact, the AVG was still in training at Toungoo when word of the Pearl Harbor attack reached Burma. The 55 remaining P-40s were divided among the three squadrons, and three pilots flew a photo recon mission to Bangkok, Thailand, on December 10, the AVG's first combat operation.

The 3rd Pursuit Squadron under the command of Arvid E. Olson Jr was sent to Mingladon Airdrome, outside Rangoon, on December 11 to bolster RAF Buffalo squadrons assigned to protect the city. The 1st and 2nd Squadrons were ordered north to China, where they would protect Kunming, the terminus of the Burma Road. It was at Kunming, on December 20, that the AVG had its first air battle when unescorted Japanese bombers approached from Indochina with the intent of attacking the city. With ample warning from Chennault's air raid net, the 2nd Squadron under Jack Newkirk attacked about 30 miles south of the city, with Robert Sandell's 1st Squadron joining the fight a few minutes later. Several bombers were shot down, though the exact number is a matter of some dispute. But the important fact was that the Japanese quickly jettisoned their bombs and turned for home without reaching the city, and they did not attempt to bomb Kunming again for more than a year.

The 3rd Squadron got its initial taste of combat three days later when the Japanese raided Rangoon for the first time. The P-40s got off too late to intercept the first wave of 18 bombers, which attacked Mingladon and caused 40 casualties, but they had a stiff battle with the second wave of 27 bombers plus escorting Ki-27 fighters. Twelve pilots of the 3rd Squadron claimed 11 victories, plus five probables and 10 damaged. However, three P-40s were shot down and Henry G. Gilbert Jr was killed, the first AVG combat fatality. December 24 was quiet, but the Japanese attacked Rangoon again shortly after midday on Christmas Day. This time, the Japanese formations included 25 new Type 1 (Ki-43) Hayabusa fighters, which had been flown up to Thailand from Malaya to counter the AVG/RAF interceptor force. The 3rd Squadron scrambled 13 P-40s, accompanied by a similar number of Buffalos. A ferocious 30-minute air battle ensued as bombs again rained down on Mingladon before the Japanese withdrew over the Gulf of Martaban. Flight

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Chinese ground crewmen work on Hawk No. 52 of the 2nd PS AVG at Kunming during 1942. Camouflage netting is draped over the plane.

Leader William N. Reed was one of the P-40 pilots who gave chase and made several attacks before diving away when his guns jammed. He reported this account in his diary:

> I saw another P-40 who was also leaving the scrap. By now we were 140–150 miles across the gulf from Rangoon. I joined the other ship and saw it was [Parker] Dupouy. We started back across the gulf at 17,000 feet and had gone only about 30 miles off the shore of Moulmein when we spotted three Type Os [actually Ki-43s] in a V-formation below us, apparently heading home. We dropped down on their tails and surprised them. Dupouy was following me as I picked out the right-hand wingman. I fired from about 50 yards, and Dupouy fired behind me. The Jap exploded right in front of my face. I pulled sharply up to the right to avoid hitting him, and Dupouy pulled up to the left. In doing so, his right wing clipped the other Jap wingman's ship right in the wing root, and the Jap spun into the gulf, too.

Reed and Dupouy had come out on top in the first of many hundreds of combats pitting P-40s and Ki-43s that would follow over the next three and a half years. In all, the 3rd Squadron claimed another 24 victories for the loss of two P-40s but no pilots. Two pilots, Charles Older and Robert "Duke" Hedman, scored five victories each over the course of the two intercepts to become the first AVG aces. Two ground crewmen suffered minor injuries from the bombing at Mingladon. The 3rd Squadron scrambled against high-flying recon aircraft several times without success over the next three days before transferring to Kunming on December 29, while the 2nd Squadron took over at Mingladon.

The defense of Rangoon continued through the end of February, when the approach of the Japanese army forced the Allies to withdraw. The 2nd Squadron flew several successful offensive missions into Thailand early in January and then, reinforced by members of the 1st Squadron, fought a series of combats over the city during the last week of the month. Victories continued to pile up in February, though it was becoming clear that Rangoon could not be held much longer. The tactics of the JAAF changed in the face of the stiff

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When the AVG disbanded on July 4, 1942, its planes were transferred to the newly activated 23rd FG of the USAAF. This tired Hawk, assigned to the 76th FS and renumbered 145, is parked alongside several P-40Ks. (Robert Ellis)

AVG opposition, as increasingly smaller numbers of bombers set out for Rangoon with increasingly larger numbers of escort fighters. Though mindful of Chennault's instructions to concentrate on attacking the bombers, the AVG pilots found it difficult to break through the escorts. The AVG's last interception over Rangoon took place on February 26. Flight Leader Charlie Bond's account of his experience that day, which appeared in his book, *A Flying Tiger's Diary*, describes a classic example of Chennault's combat tactics at work:

> We had barely reached 18,000 feet when we spotted a formation of 15 Jap bombers and some 20 or 30 fighters. I had joined Bob Little's flight, and it appeared to me that he had not seen the bandits yet. I pulled up to him and waggled my wings pointing off to the left: Away we went. We had to get a little more altitude to come in from above the fighter escort. While climbing I found myself engaged by four fighters. I took a quick peek to my rear to see if anyone was with me. Hell, I was by myself!
>
> I attacked, and I was head-on with one of the fighters. We barely missed each other. I turned to see if he was on fire. He wasn't, and he was easily turning inside of me. Immediately, two others were on my tail. I half-rolled and went into a vertical dive – everything forward. Pulling out and up again, I got into position to make another attack. He saw me coming and went into a left turn. I led him a lot and squeezed the trigger. His ship straightened up a little, and then started off in a steep spiral with smoke trailing. I pulled up in a shallow climb to follow him.
>
> My speed had fallen off, and when I looked back I saw two Jap fighters smack-dab on my tail. Their guns were spitting smoke. Again, quickly into a Split-S with full throttle. They followed. All I could do was hunch up behind my armor plate and wait for my acceleration to pull me out of their firing range. None of their bullets hit my fuselage, but I got a few in my left wingtip. When I got out of range they pulled away. Climbing back up, I could find no more enemy. John Blackburn joined on my wing, and we returned home.

G

AVG RAID ON MOULMEIN, MARCH 18, 1942

Of all the notable successes recorded by the legendary American Volunteer Group over Burma and China, one that stands out is a two-plane strafing mission by William Reed and Kenneth Jernstedt on March 18, 1942. Taking off from Toungoo, Burma, at dawn, they flew eastward over the Gulf of Martaban, maintaining an altitude of 7,000 feet to stay under the overcast. The two P-40s crossed over the coast south of Moulmein, then turned north to begin letting down. At 4,000 feet Reed spotted an auxiliary airfield at Moudon with 30–40 Japanese aircraft on it and led Jernstedt down to attack. They made six unopposed passes and set several aircraft on fire before proceeding to the main enemy airdrome at Moulmein. Reed reported in his diary:

"Once more an attack signal and the low-angling dive with all guns blazing at a field loaded with heavy bombers. This time we met heavy antiaircraft [fire], though, and as I pulled up and turned for another dive I saw Jernie crossing the field with little black mushrooms of smoke bursting all around him. I made one more pass and set another plane on fire, but the antiaircraft fire was pretty heavy and too damned close, so I continued on north across the bay."

Jernstedt, meanwhile, spotted a fighter on the runway attempting to take off and blasted it with machine gun fire before swooping over a hangar and attempting to launch a small bomb at it through the flare compartment in his plane. He missed the hangar, but hit a Ki-21 bomber parked nearby before making good his escape back to Toungoo. Reed was credited with eight aircraft destroyed on the ground and Jernstedt with seven.

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The last fight over Rangoon resulted in 1st Squadron claims of eight victories, only one of which was over a bomber. Bond was given credit for one fighter destroyed. Japanese ground forces entered the city on March 8, 1942. Tallies of the AVG's total victories scored during two months of fighting over Rangoon vary widely. Newspaper accounts at that time, for instance, put the AVG's score for February 25 and 26 alone at a staggering 104 victories. At the extreme other end of the spectrum, recent studies of surviving Japanese records of aircraft losses suggest drastically lower AVG scores during the defense of Rangoon. Modern historians estimate the AVG destroyed about 50 Japanese aircraft for the loss of 20 P-40s during the defense of Rangoon.

With the loss of Rangoon, China's last overland supply route was cut. The Japanese already occupied all of China's port cities, and Hong Kong had fallen on December 25, 1941. After a short period to regroup, Japanese invasion forces set out from Rangoon with the intention of pushing all the way through Burma and into India and China. The AVG's new mission became the defense of China proper, though its planes continued to oppose the Japanese advance through Burma in March and April. Flying first from Magwe, about 200 miles north of Rangoon, and then Loiwing, just across the border in China, AVG pilots continued to give out more punishment than they received. By this time, replacement P-40Es had begun to arrive to offset losses of the original AVG P-40s.

Pilots of the 1st and 3rd Squadrons claimed 12 victories for no losses over Loiwing on April 8, and a scrap with Ki-43s over Lashio on April 28 produced claims of 15 victories, again for no losses. But still the Japanese ground advance continued, and within a few days the AVG had pulled back to airbases closer to Kunming. Chennault deployed aircraft to bases at Kweilin and Hengyang in the eastern part of Nationalist-controlled China in June, where several more successful intercepts took place before the AVG was disbanded on July 4, 1942.

The AVG was officially credited with 297 enemy aircraft destroyed, including 229 in the air. Modern researchers put the figure much lower, but the true figure – whatever it might be – is irrelevant. The AVG's successes gave the American people something to cheer about during the dark days of 1942 when the war was going very poorly for the Allies. The Flying Tigers also proved that the P-40, when deployed skillfully and flown with proper tactics, was a tough and capable fighter with sufficient performance to hold its own against contemporary Japanese warplanes.

The end of the AVG did not mean the end of the long-nosed Hawks in China, however. The 23rd Fighter Group, USAAC, was activated to replace the AVG, and the remaining P-40s were assigned to the new unit. The long-nosed Hawks were concentrated in the 74th Fighter Squadron, which was assigned the job of training the least experienced new Army pilots as they arrived in China.

As best can be determined, the last combat involving an ex-AVG long-nosed P-40 took place on September 8, 1942, the day the 74th FS scored its first confirmed victory. Lt Thomas R. Smith was on alert duty at Kunming when he was ordered to intercept an aircraft approaching the base from the southeast. Flying P-40 No. 46, Smith climbed as fast as the old plane would go and spotted a twin-engine Ki-46 Dinah at 24,000 feet about 15 minutes after taking off. Smith pulled in as close as he dared behind the Ki-46 and opened fire. His first burst hit the Dinah's left engine, and then he put several bursts into the right engine as the plane began to

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trail flames. Smith watched as the Dinah nosed over into a dive and went straight into the ground.

Several long-nosed P-40s remained on strength in the 23rd FG until early 1943, when the last ones were ferried to Karachi, India, for duty in the replacement training unit being established there. As their useful lives neared the end, these aircraft were employed to prepare Chinese pilots of the newly formed Chinese–American Composite Wing for future combat duty in China.

CONCLUSION

Airplanes are machines, and like all machines the Curtiss P-40 was a collection of compromises. At the very beginning, the Army specification for a fighter that produced its top performance at medium altitude was a tradeoff, because requiring a high-altitude fighter would have added a year or more to its development period. In 1939, with a war in Europe looming, the United States could not wait that long to begin building up its fighter strength.

To create the P-40 quickly, designer Donovan Berlin started with an existing radial-engine aircraft and converted it to an inline, liquid-cooled powerplant rather than designing an all-new fighter. This compromise gave the P-40 a streamlined nose that added speed to the H-75 airframe, but it also added weight that reduced its maneuverability and rate of climb.

Each modification to improve the P-40's combat capability – more guns, armor plating, self-sealing fuel tanks in particular – added still more weight that further degraded the plane's performance. It is a testament to the excellence of Berlin's original H-75 design that it could be stretched as far as it was and still remain a competent – and in some scenarios superior – combat aircraft. That was an important factor in establishing the long-nosed P-40's place in military aviation history.

The P-40 may not have been the fastest, highest flying or most maneuverable fighter of World War II, but in nearly every combat confrontation it had the advantage in at least one of those performance categories. When flown by pilots who knew how to exploit its advantages and minimize the effect of its shortcomings compared to the opposition, the P-40 could do well in air

The final production version of the P-40, the N model, was produced in greater numbers than any that came before. This P-40N, named "Irish," flew in the 11th FS/343rd FG in the Aleutian Islands, 1944–45. (Craig Busby)

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combat. North Africa provides a perfect example of this. There, many of the Commonwealth pilots had previous combat experience and knew how to use their Tomahawks' superior maneuverability to offset the Bf 109E's advantages in service ceiling and speed. In contrast, in China Chennault taught his AVG Tomahawk pilots just the opposite: to use the P-40's superior speed, diving performance, and firepower against the highly maneuverable but lightly armed Japanese opposition. A further quality that endeared the P-40 to most pilots was its ability to absorb combat damage.

It is well known that the story of the P-40 did not end when the H-81 went out of production in 1941. By then, a change in the design of the Allison V-1710 had led Curtiss completely to reconfigure the fuselage of the P-40 to accommodate the new thrust line of the engine. Curtiss gave this version a new designation, the Hawk 87, and the RAF called it the Kittyhawk. However, the US Army merely labeled it with the next letter in the P-40 series, which made it the P-40D. The Hawk 87 continued to be refined throughout much of World War II, the final P-40N-40 rolling off the production line in December 1944. But that is a story for another book.

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